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VOL. CXLVII.—No. 3831] LONDON: FRIDAY EVENING, JUNE 14, 1929 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 2nd July, 1929, for EXTENSION of the ACCELERATED LOW-PRESSURE HOT WATER HEATING at the Natural History Museum, South Kensington, S.W.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 2165

Air Ministry.
DIRECTORATE OF SCIENTIFIC RESEARCH.

ONE SCIENTIFIC OFFICER and ONE JUNIOR SCIENTIFIC OFFICER are REQUIRED for the Air Ministry Scientific Research Staff, primarily for duty at the Royal Aircraft Establishment, South Farnborough.

The duties and qualifications required are as follows:—Ref. No. A. 349.—A Scientific Officer for research in aerodynamics.

Candidates should possess a First Class Honours Degree in Natural or Applied Science or in Mathematics, and should have had experience of research.

Salary £250 plus Civil Service bonus, giving a present total starting salary of £361 3s. on the scale £250-£20-£350-£20-£450 plus bonus per annum, with an efficiency bar at £350 basic.

Ref. No. A. 398.—A Junior Scientific Officer is required to assist with research in connection with aeronautical instrument work. Candidates should possess a First Class Honours Degree in Natural or Applied Science or in Mathematics. Some aeronautical training or experience would be an additional recommendation.

Salary £175 plus Civil Service bonus, giving a present total starting remuneration of £265 19s. on the scale £175-£15-£235 plus bonus per annum.

All candidates should be medically fit for flying duties and be willing to fly as observers in aircraft.

All appointments carry superannuation under the Federated Universities Superannuation Scheme; Government contribution being 10 per cent. of salary, individual contribution 5 per cent.

Preference given, other things being equal, to ex-Service men.

Applications should be made on a form to be obtained from the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants (quoting appropriate reference number), to whom it should be returned not later than 6th July, 1929. 2164

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS:—

M/1579.—ENGINEER (ARCHITECTURAL) REQUIRED by the GOVERNMENT of HONG KONG for the Public Works Department for three years' service and possible permanency. Salary £460 a year, rising by annual increments of £20 to £500 a year, and thereafter, in the event of the appointment being made permanent, by further increments to a maximum of £1000 a year, payable in dollars under the Compensation Scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, unmarried, 23 to 30 years of age, must be Associates of the R.I.B.A. and be conversant with all the usual routine of an Architectural Office, including the preparation of sketch plans and working drawings, specifications, quantities, measuring, &c., in connection with new buildings, additions and alterations. Some knowledge of steel and reinforced concrete design and construction is also necessary.

M/1539.—ENGINEER REQUIRED by the GOVERNMENT of HONG KONG for the Public Works Department for three years' service, with possible permanency. Salary £460, rising to £500 a year by annual increments of £20 and thereafter, if, the appointment becomes permanent, rising by annual increments to a maximum of £1000 a year, payable in dollars under the Compensation Scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, 25 to 30 years of age, single, must have passed examinations for Sections A and B of the A.M.I.C.E. Diploma or hold professional qualifications accepted by the Institution of Civil Engineers as exempting from those examinations. Must be good draughtsmen and be proficient in land surveying and levelling. Should have had experience in waterworks, maintenance and administration work of a large city, including house services, meterage, mains, waste prevention and general distribution, and the preparation of plans, specifications and estimates for waterworks construction, such as storage and service reservoirs, filter beds, &c.

Apply at once by letter, stating age and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made.

M/1574.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of UGANDA for the Public Works Department for a tour of 20 to 30 months' service and possible extension. Salary £480, rising to £600 a year by annual increments of £20, and thence rising to £720 a year by annual increments of £30. Free quarters and passages. Liberal leave on full salary. Outfit allowance £30 on first appointment. Candidates, preferably single, 25 to 30 years of age, must have passed Sections A and B in the examination for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Must have had experience in the construction and maintenance of buildings and preferably had training and experience in Municipal Engineer's office. Some knowledge and experience of bridge construction is also desirable.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 2210

Department of Scientific AND INDUSTRIAL RESEARCH.

JUNIOR ASSISTANT REQUIRED at the Forest Products Research Laboratory, Princes Risborough, Bucks. Candidates should have an Honours Degree in Engineering, with good standing in mathematics and physics, and a good working knowledge of testing strength of materials. Scale of salary £175-£15-£235 plus Civil Service bonus; initial pay approximately £265. Superannuation provision will be made under the Federated Superannuation System for Universities.

Application must be made on a form to be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen-street, Westminster, S.W. 1, to whom it must be returned not later than June 25th, 1929. 2163

The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for:—

SCHEDULE 1.—12 LOCOMOTIVE BOILERS with Cylinders and other equipment.

SCHEDULE 2.—4 LOCOMOTIVE BOILERS, with Cylinders and other Equipment.

SCHEDULE 3.—3 BOGIE PETROL TANK WAGONS and 6 BOGIE OIL TANK WAGONS, Metre Gauge.

SCHEDULE 4.—230 WELDLESS STEEL TUBE SIGNAL POSTS.

Tenders due as follows:—
Schedule 1, 2nd July, 1929.
Schedules 2 and 3, 5th July, 1929.
Schedule 4, 9th July, 1929.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 2222

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.
FULL-TIME COURSES IN ENGINEERING
are provided as follows:—
MECHANICAL.
CIVIL.
AERONAUTICAL.
ELECTRICAL AND
ELECTRICAL COMMUNICATION.

Students are able to qualify for the Polytechnic Diploma and (if matriculated) the Engineering Degree of London University.

For prospectus giving particulars as to fees, &c., apply to
2099 THE PRINCIPAL.

The Polytechnic, 309, Regent STREET, LONDON, W. 1.

The Governors invite APPLICATIONS for the POST of HEAD of the SCHOOL OF ENGINEERING (Day and Evening), rendered vacant by the appointment of Mr. Alex. R. Horne, B.Sc. (Hon. Eng.), F.R.S.E., to the Professorship in Mechanical Engineering at the Heriot-Watt College, Edinburgh, as from 1st September.

Candidates should possess good academic qualifications and should have had practical and teaching experience. Salary in accordance with the Burnham Technical Scale for London for Heads of Departments (Grade Ia., £730 by £25 to £930).

Application should be made on or before 28th June on the prescribed form, which may be obtained (on receipt of a stamped addressed foolscap envelope) from the DIRECTOR OF EDUCATION, 2201

PUBLIC NOTICES

University of Durham.
ARMSTRONG COLLEGE, NEWCASTLE-UPON-TYNE.
LECTURESHIP IN MECHANICAL ENGINEERING.

The Council of Armstrong College invites APPLICATIONS for a LECTURESHIP in MECHANICAL ENGINEERING. Salary £300 to £400, according to qualifications. Candidates must have had practical experience. Duties to commence on 1st October, 1929. Ten copies of applications and of not more than three testimonials should be lodged, not later than Saturday, 22nd June, 1929, with the undersigned, from whom further particulars may be obtained.

J. Y. T. GREIG,
Registrar,
2070 Armstrong College.

University of London.
UNIVERSITY COLLEGE.

An ASSISTANT is REQUIRED in the Mechanical Engineering Laboratory of University College, London, with a First Class Honours Degree in Engineering and a thorough knowledge of workshop practice.

Commencing salary £300 per annum.

Further particulars may be obtained from the undersigned.

C. O. G. DOUIE,
Secretary.
University College, London (Gower-street, W.C. 1). 2166

Poplar Board of Guardians.
HEATING INSTALLATION.

The Poplar Board of Guardians are desirous of obtaining TENDERS for a CENTRALISED ACCELERATED HOT WATER HEATING SYSTEM, to be installed at the Poplar Institution, High-street, Poplar, E. 14.

A list of suitable firms wishing to Tender for this work will be prepared, from which not less than six will be selected and to whom the plans and the specification will be submitted by the Consulting Engineer to the Board, Mr. E. G. Phillips, M.I.E.E., M.I. Mech. E., for the purpose of receiving Tenders which will be duly considered by the Guardians.

Application for inclusion in the list from which selection will be made should be addressed to

G. BUTLER,
Clerk to the Guardians,
45, Upper North-street, Poplar, E. 14,

to reach his office not later than first post Saturday, the 22nd June, 1929.

Tenders from selected firms will be opened at a meeting of the Board to be held on Wednesday, the 10th July, 1929.
June, 1929. 2211

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for:—

25 H.S.M. BOILERS for H.M. CLASS ENGINES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Tuesday, 11th June, 1929.

A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Tuesday, 25th June, 1929.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
2193 Secretary.

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 5th July, TENDERS for the SUPPLY of:
1. LAMINATED BEARING SPRINGS.
2. TYRES for LOCOMOTIVES.
3. STEEL MATERIAL (CHANNELS, ANGLES, PLATES, FLATS, &c.);

and up to 2.30 p.m. on Wednesday, 3rd July, TENDERS for the SUPPLY of:—
4. COPPER FIRE-BOX PLATES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each for Nos. 1, 2 and 4, and £1 each for No. 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices, The White Mansion, 91, Petty France, Westminster, S.W. 1, 12th June, 1929. 2213

Borough of Richmond (Surrey).
WATERWORKS DEPARTMENT.
TENDERS FOR SINKING AND LINING A WELL.

The Corporation invite TENDERS from experienced contractors for SINKING and LINING (with Cast Iron Segments) a WELL about 22ft. 6in. deep, in the Old Deer Park, Richmond, Surrey.

Specification, quantities, form of Tender, &c., may be obtained from Mr. H. P. Williamson, M.C., M. Inst. C.E., Water Engineer and Manager, Hotham House, Heron Court, Richmond, Surrey, on payment of £2, which will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Well in the Old Deer Park," should be delivered to the undersigned not later than 10 a.m. on Monday, the 24th day of June, 1929.

The Corporation do not bind themselves to accept the lowest or any Tender.

EDWIN M. NEAVE,
Town Clerk.
Town Hall, Richmond, Surrey, June, 1929. 2217

Egyptian Government.
ASWAN DAM.

TENDERS are INVITED by the Ministry of Public Works of the Egyptian Government for the HEIGHTENING of the ASWAN DAM on the river Nile.

The contract documents, drawings and regulations for tendering may be inspected on and after June 11th, 1929, at the offices of the Consulting Engineers, Sir M. MacDonald and Partners, 72, Victoria-street, London, or after June 18th at the Ministry of Public Works, Cairo.

Contractors desiring to Tender may obtain copies of these documents from either of the above offices upon payment of Twenty Pounds Egyptian, and after making a deposit of Five Thousand Egyptian Pounds in cash.

On submission of Tender a total deposit of two per cent. of the amount tendered must be made. The preliminary deposit of Five Thousand Egyptian Pounds mentioned above will be accepted as part thereof.

These deposits will be held as a guarantee of good faith on the part of the firms making them.

Only Tenders from firms who have previously executed similar works will be considered.

The Tenders must be submitted to His Excellency the MINISTER OF PUBLIC WORKS, Cairo, before midday on September 14th, 1929.

A memorandum for persons tendering is now available and can be obtained from Sir M. MacDonald and Partners, 72, Victoria-street, London, S.W. 1. 2177

NORTHERN INDIA
ENGINEERING DEVELOPMENT.

Many huge projects are completed, others are under construction, and still more are under consideration. When tendering, remember that we have handled, inter alia, all the material for the Lloyd Barrage, the largest irrigation scheme in the world, and that WE HAVE THE EXPERIENCE to enable us to quote you the most favourable terms for CLEARING and DESPATCHING up country any quantity of material to any site required.

For full particulars apply, EASTERN EXPRESS CO., Ltd., Karachi; or to Messrs. FORBES, FORBES, CAMPBELL and CO., Ltd. (Managing Agents), 9, King William-street, London, E.C. 4. P 5899

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PUBLIC NOTICES

Bombay Port Trust.

The Trustees of the Port of Bombay have for DISPOSAL the Self-propelling Ladder DREDGER "OCTOPUS," with a designed capacity of 1000 tons per hour, and the TWO Self-propelling steam HOPPER BARGES "GULL" and "HERON," each with a carrying capacity of 1000 tons.

These vessels were built as a dredging unit for the Bombay Port Trust by Messrs. Wm. Simons and Co., Ltd., Renfrew, Scotland, in 1904. They are now at Bombay and are surplus to the requirements of the Port.

The vessels are of the following dimensions :—

	Octopus.	Gull.	Heron.
Length between perpendiculars	192ft.	190ft.	190ft.
Breadth moulded	36ft.	30ft.	30ft.
Depth moulded	13ft.	15ft. 9in.	15ft. 9in
Dredging depth	44ft.	—	—
Designed speed in knots	8	10	10
Gross tonnage	661	780	783
Nominal Horse-power	132	108	108
Screws	Twin	Twin	Twin

For further particulars, apply to the CONSULTING ENGINEERS and AGENTS, Bombay Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1, and for an opportunity to inspect the vessels, apply to the Chief Engineer, Bombay Port Trust, Ballard-road, Bombay. 2155

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

LOCOMOTIVE TURNTABLE (85ft. diameter for 5ft. 6in. Gauge).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited marked :—" Tender for Locomotive Turntable," with the name of the firm tendering, must be left with the undersigned not later than 12 Noon on Friday, the 28th June, 1929.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of the Specification.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
Westminster, S.W. 1.
12th June, 1929. 2223

County Borough of Brighton.

WATERWORKS DEPARTMENT.
DRAUGHTSMAN.

APPLICATIONS are INVITED for the APPOINTMENT of a DRAUGHTSMAN in the above Department, at a commencing salary of £4 per week.

Candidates should not be more than 35 years of age and must be neat and expeditious Draughtsmen and good Surveyors and Levellers. Previous experience in a Waterworks Engineer's Office is necessary, and candidates should possess a sound knowledge of Building Construction, Service Reservoir Design, and Pipework. Other things being equal, preference will be given to persons who have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers.

Applications, stating age, qualifications and experience, accompanied by copies of not more than three recent testimonials, and endorsed "Draughtsman," should be addressed to me and delivered at my office not later than Wednesday, the 19th inst.

A. B. CATHCART, M. Inst., C.E.,
Waterworks Engineer.

12, Bond-street, Brighton,
5th June, 1929. 2142

Egyptian Government.

EGYPTIAN MINISTRY OF EDUCATION.

APPLICATIONS are INVITED for the following POSTS, which will become vacant in the Royal School of Engineering, Giza, Cairo, in September, 1929 :—

1. PROFESSOR of MUNICIPAL ENGINEERING and TOWN PLANNING.
2. PROFESSOR of RAILWAY and ROAD ENGINEERING.

Applicants should have a University or other Engineering Degree and good practical experience. Experience in teaching will be considered a recommendation.

The salary offered is £E1200 a year (about £1230), and the appointment will be on contract for three years and will be renewable at the end of that time.

Applications should be sent to the DIRECTOR, Egyptian Education Office, 39, Victoria-street, London, S.W. 1, so as to be received not later than July 15th, 1929. 2199

Royal Victoria and Other DOCKS APPROACHES (IMPROVEMENT) ACT, 1929.

APPLICATIONS are INVITED (by letter only) for the POST of RESIDENT ENGINEER for certain works to be carried out under the above Act.

Applicants should be Chartered Civil Engineers and must have had previous experience as Resident Engineer on large public works.

Commencing salary £800 to £1000, according to qualifications.

Applicants must forward details of career, including practical training and subsequent experience, with names of employers, appointments held and dates of such employment, together with copies only of testimonials, to the undersigned as soon as possible, but in any case not later than the 21st July.

RENDEL, PALMER and TRITTON,
P5902 25, Charles-street, Haymarket, S.W. 1.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT SUPERINTENDENT for large works engaged on light mass production. Successful executive experience as well as a good practical knowledge of tools and methods necessary.—Address, 2182, The Engineer Office. 2182 A

WANTED, ENGINEER, with Some Experience in selling Hand and Machine Tools, by London Merchants and Stockholders.—Write, Box N, 121, Willing's, 133, Moorgate, E.C. 2. P5904 A

WANTED, ELECTRICAL ENGINEER, with Good experience for Oilfield in Burma. Drawing-office experience a recommendation. Single man, not over 30. First agreement 3 years. Salary, excluding allowances but including Provident Fund, Rupees 3900, Rupees 4550, and Rupees 5200 per annum. Passage paid. Medical expenses and furnished quarters free.—Write, giving age, full particulars of experience and copies of testimonials, to Z.K. 440, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 2209 A

ASSISTANT ENGINEER REQUIRED by Consulting Engineers for Port Works, East Africa. Salary £30 to £40 per month, according to qualifications. Selected applicant must pass medical examination.—Apply to Box 2833, c/o Brown's, 39, Tothill-street, S.W. 1. 2167 A

ASSISTANT MANAGER WANTED for Shipyard and Engineering Works in China. Age about 40. One who has been trained as a technical and practical engineer with knowledge of Shipbuilding, also Ship and Engine Repairs. One who is energetic and has already held a responsible or similar position preferred.—Address, stating age, detailing experience and qualifications, also salary expected, P5882, The Engineer Office. P5882 A

CONSTRUCTIONAL ENGINEERS in London REQUIRE SERVICES of STEEL WORK DESIGNER with similar experience. Give full particulars, age, experience, &c. Permanency.—Address, 2200, The Engineer Office. 2200 A

D. NAPIER and SON, Ltd., and REDUCED, Acton Vale, London, W. 3, REQUIRE experienced ENGINEER, to Take Charge of Jig and Tool Design and Tool Production; also experienced CHIEF RATE FIXER.

Applicants for either appointment must have held a similar position and been used to very high-class production.

Applications, giving full details of experience, in date order, age and salary required, should be addressed to LABOUR OFFICER. 2120 A

ENGINEERING ASSISTANT to WORKS MANAGER, with experience of Non-ferrous Metal Trade. Age under 30. State experience, salary required, &c.—Address, 2187, The Engineer Office. 2187 A

GRADUATE in SCIENCE, with Some Engineering experience, REQUIRED for the patent department of a well-known firm.—Address, stating age, qualifications, experience, and salary required, 2194, The Engineer Office. 2194 A

IMPORTANT GROUP, Not Acquainted with or Connected with electric cable making in England, are anxious to OBTAIN the ADVICE and ASSISTANCE of an ENGINEERING MANAGER capable of advising upon the technology of the manufacture of Power and Lighting Cables.

Applicant must be competent to equip and start up a factory.

Address, P5876, The Engineer Office. P5876 A

MANAGER (Experienced) WANTED for Artificial Stone Works in the North of England making all grades of moulded goods.—Write, Box No. A.S. 22, c/o Advertisement Dept., 5, New Bridge-street, London, E.C. 4. 2179 A

MECHANICAL ENGINEER REQUIRED in Established London business connected with engineering. Investment £3000. Return for services and capital should be £1000 p.a. Full investigation.—Address, 2195, The Engineer Office. 2195 A

MECHANICAL ENGINEER REQUIRED, to Assist in management of well-established highly profitable gravel pit near London, at present managed by the proprietors, who propose retiring from active duties in due course, being elderly men. Must be between 30-40, of outstanding ability and experience, both engineering and commercial, have intimate knowledge of Steam and Petrol Engines; healthy, energetic and unblemished reputation; able to deal with men and affairs, and preferably a public school man. One or two months' trial will be given so that both parties may satisfy themselves before concluding the transaction. Neither the proprietors nor the business are in any need of money, but it is a sine qua non that the incoming partner should purchase for cash a substantial share in the undertaking, the whole object of this offer being to obtain his wholehearted absorption in the business. He will be debarred from taking up any other business interests that would make calls upon his time or energies. In addition to his salary, his shareholding should prove highly profitable and capable of great expansion. Replies from solicitors (none others will be entertained) must contain fullest particulars of qualifications and state cash available.—Address, P5910, The Engineer Office. P5910 A

REFRIGERATION COMPANY (London) REQUIRES SEVERAL energetic SALES ENGINEERS to sell Medium-size Commercial Plants. Salary and commission.—Address full particulars 2212, The Engineer Office. 2212 A

SALESMAN MANAGER for London Office and Warehouse handling special alloys; knowledge of Engineering and Chemistry essential; must have first-class interviewing ability with good education and address. Progressive position for able and energetic man.—Address, 2024, The Engineer Office. 2024 A

SUPERINTENDING OUTSIDE ERECTION ENGINEER WANTED IMMEDIATELY, to Handle Contracts for Waterworks Plant, including Centrifugal Pumps, Electrical Machinery, Diesel Engines, &c. —Apply, giving full particulars of qualifications, experience, and salary required, to the BUSINESS MANAGER, Harland Engineering Co., Ltd., Alloa, Scotland. 2162 A

TRAVELLER WANTED for Lancashire and Yorkshire by Manchester Firm of Engineers for Pumps, Valves and Mill Furnishing; must be practical man. State age and salary expected.—Address, 2175, The Engineer Office. 2175 A

WANTED, Experienced MARINE ENGINE DRAUGHTSMEN, accustomed to Machinery and Pipe Arrangements for High-class Vessels; also good BOILER DRAUGHTSMAN. West Coast district. Good salary and prospects for first-class men.—Address, 2160, The Engineer Office. 2160 A

WANTED IMMEDIATELY, THREE Good DRAUGHTSMEN, experienced in the design and detailing of Light Structural Steel Work. Only first-class men need apply. State age, experience, and salary required.—MILLIKEN BROTHERS and BLAW-KNOX, Ltd., Wellington House, Strand, W.C.2 P5896 A

AN Experienced DESIGNER for Reciprocating and Direct-acting Pumps, high and low pressure, Well and Bore-hole Pumps; also an IMPROVER. State age, experience, and salary.—Address, 2218, The Engineer Office. 2218 A

DRAUGHTSMAN and ESTIMATOR, Experienced in designing Hot Water and other Warming Plants for buildings. Good opportunity for suitable man. —Write, stating age, experience, and salary required, to HOPE'S HEATING and LIGHTING, Ltd., 59, Berners-street, London, W. 1. 2150 A

DRAUGHTSMAN DESIGNER, Experienced, for Commercial Vehicle and 'Bus Chassis Layout and Design of Components. Permanency, near London. Age, experience, and salary.—Address, 2093, The Engineer Office. 2093 A

DRAUGHTSMEN, JIG and TOOL DESIGNERS, REQUIRED for small accurate work, S.E. London district.—Write, giving particulars of past experience, age, and salary required, Box 109, Advertising Offices, 84, Queen Victoria-street, London, E.C.4. 2205 A

DRAUGHTSMAN, Mechanical, with Experience of Power Transformers preferred.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 2106 A

DRAUGHTSMAN, Mechanical-electrical, with General experience of Electrical Apparatus.—Address, stating age, experience, and salary required, 2107, The Engineer Office. 2107 A

DRAUGHTSMAN REQUIRED, Birmingham District, for Machinery and Electrical Plant Layouts, &c. State age and experience.—Address, 2190, The Engineer Office. 2190 A

DRAUGHTSMAN REQUIRED in London Office of Firm of Engineers. Draughtsman with knowledge of Conveying and Mechanical Handling Plants. Experienced men only need apply, stating age experience, and salary.—Address, 2203, The Engineer Office. 2203 A

DRAUGHTSMEN REQUIRED, London Office, Experienced in detailing General Structural Steel Work. Good salary to suitable men.—Address applications, stating age and experience, P5897, The Engineer Office. P5897 A

DRAUGHTSMEN, Preferably with Experience of Cranes or Ropeways.—Apply, giving full particulars of experience, wages, age, when free, to CHIEF DRAUGHTSMAN, John M. Henderson and Co., Ltd., King's Works, Aberdeen. 2161 A

DRAUGHTSMAN REQUIRED, with First-class Experience in Reinforced Concrete design. State age and salary required, also give particulars of training and class of work engaged upon recently.—Address, 2104 The Engineer Office. 2104 A

DRAUGHTSMAN WANTED, Fully Experienced in all classes of Centrifugal Pumps.—Apply, stating experience, age, married or single, and wages expected, to W. H. ALLEN, SONS and CO., Ltd., Queen's Engineering Works, Bedford. 2123 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Mild Steel at High Temperatures.

SOME time ago the Department of Scientific and Industrial Research appointed a committee under the chairmanship of Engineer Rear-Admiral W. M. Whayman to direct researches on the behaviour of materials at high temperatures. The committee's first report published in 1927 dealt with the mechanical properties of Armco iron, 0·17 per cent. carbon steel, and 0·24 per cent. carbon steel, and paid special attention to the phenomenon of creep. Its second report published in the same year dealt similarly with the properties of 0·51 per cent. carbon steel and 0·53 per cent. carbon cast steel. The third report published in 1928 was devoted to a further study of the creep of Armco iron. The committee's fourth report published last week continues the work begun in the first report on the 0·17 per cent. carbon steel. In the earlier investigation the properties of this steel were studied at temperatures up to 500 deg. Cent. In the fourth report the range of temperatures covered is extended up to about 650 deg. Cent. In addition, the report gives the results of tests on a 0·10 per cent. carbon steel between 500 deg. Cent. and 650 deg. Cent. The work described in the fourth report was carried out by Messrs. Batson and Tapsell at the National Physical Laboratory and was undertaken at the request of the Board of Trade, which desired to have further information concerning the effect of high temperatures on the mechanical properties of material used for boiler and superheater tubes and superheater and steam drums. The results are not sufficiently full or decisive to enable a complete discussion of "creep" at high temperatures to be given. Further investigations are in hand.

Inter-Planetary Navigation.

HAVING devised means for transporting himself beneath and on the surface of the land and of the sea and through the air, there is no other field of transportation open to man except inter-planetary space. Certainly of all Jules Verne's fancies the voyage to the moon is the only one which in some degree or other is not to-day an accomplished achievement. There are quite a number of serious-minded scientists, however, who do not despair of adding inter-planetary navigation to the list. Two or three years ago no less august a body than the Smithsonian Institute sponsored an American physicist's scheme for discharging a rocket at the moon. There is, too, in existence a prize valued, perhaps with a certain amount of intentional sarcasm, at about £100, which was founded by two well-known Frenchmen, Messieurs R. Esnault-Pelterie and André Hirsch, for the best scientific exposition or practical invention designed to promote the realisation of inter-planetary navigation. We have, then, to take this subject seriously. To treat it with levity would be to offend the Astronomical Society of France, which has just been engaged on the selection of a suitable recipient for Messieurs Esnault-Pelterie and Hirsch's prize. It has awarded it to Professor H. Oberth, a German savant resident in Roumania. Herr Oberth believes that the best way of traversing the space between the earth and the moon is by means of two rockets, one containing alcohol and the other hydrogen. So far as our information goes, we gather that the plan is to make use of presumably the hydrogen to effect the regeneration of the alcohol after it has been consumed for the production of the propelling force. Comment on the scheme with so few particulars available is impossible. Another German, Professor Hohmann, submitted a scheme which, though no particulars of it have reached us, is stated to have impressed the French scientists favourably.

The Growth of Flying.

SIGNS are not wanting that the growth of private flying in this country is proceeding at an accelerated pace, but whether the expansion is sufficient to justify us in believing that the "new air era" is about to arrive depends upon the precise interpretation which we give to that popular phrase of the daily Press. In the United States they have no doubt about the situation. The "new air era" is to arrive within a twelvemonth. As evidence of its near advent attention is called to the fact that a large "mail-order" house is now prepared to deliver at one's doorstep a miniature aeroplane ready for flight for the sum of £200. The machine is described as a "fool-proof super-parasol monoplane." It has a wing span of only 25ft., weighs 260 lb., and has a speed stated to be 70 miles an hour. It is confidently anticipated that many thousands of the company's numerous postal customers will shortly be placing orders for the machine. The fool-proof aeroplane is difficult to imagine, and, in any event, those of us who prefer to remain on the ground must deplore any encouragement given to fools to take to the air, however proof against their foolishness their machines may be made. On one point, however, the description of the company's machine would appear to be unexceptionable, namely, in its characterisation of the machine as a "super-parasol" monoplane. The parasol design of monoplane has long been familiar to students of aeronautics, but in America the term seems to have been given a new significance. At any rate, the company's machine is to be delivered fitted virtually with a parasol in the shape of a parachute large enough when extended over the wings, engine and fuselage, to bring the machine safely to earth, together with its pilot, should any mishap occur.

The Benguela Railway.

ON Monday of this week, June 10th, the formal opening ceremony of the Benguela Railway was held at Luao, on the frontier between the Belgian Congo and the Portuguese West African Colony of Angola. The railway starts at Lobito Bay, on the Atlantic Coast of Angola, and runs almost due eastwards across Portuguese territory to Luao, its length being about 750 miles. A further 250 miles of line is now being constructed eastwards across Belgian territory to link the Benguela line with the Cape to Cairo Railway at Tshilongo, 100 miles or so south of Katanga, the centre of the vast copper-bearing region of Central Africa. When this link is completed, Africa's first trans-continental railway will come into existence, for journeying south from Tshilongo to Bulawayo the traveller will be able to continue by the Beira line to the coast of Mozambique. The Benguela Railway was begun in 1902, and was constructed on the initiative of a British engineer, Sir Robert Williams, who in 1928 was created a baronet for his work on the development of Central Africa. The construction and equipment of the railway have been carried out entirely with British materials. Under the Trade Facilities Act, the British Government guaranteed the principal and interest on nearly £2,000,000 of debenture stock issued by the promoters of the railway, on condition that the proceeds would be applied to the purchase of plant and equipment from this country. All told, it is estimated that British industry has benefited to the extent of about £9,000,000 by the construction of the railway. The new line is of very great importance to the future, not only of the Portuguese and Belgian territories of Central Africa, but also to Rhodesia and other portions of British Africa. It will shorten the distance between England and Rhodesia by no less than 2500 miles, and will greatly increase the accessibility of the fertile Central African plateau, a region possessing climatic conditions which are very suitable for European settlements.

Naval Disarmament and New Ships.

ACCORDING to Washington messages, the new American Ambassador, General Dawes, has brought with him to London certain proposals for naval reduction which are somewhat drastic in character. They are said to involve, on the one hand, the suspension of the American cruiser programme, and, on the other, the cancelling of certain British ships already begun, if not actually completed. In view of these reports, it seems opportune to note the present state of British naval construction. The 10,000-ton cruiser "Shropshire," launched last July, although well advanced, will not be completed for several months. The "Norfolk" and "Dorsetshire" of the same type, put afloat during the winter, are not to be delivered until next year. The 8400-ton cruiser "York," launched in July, 1928, is being fitted out, and her sister, "Exeter," is to take the water next month. Two cruisers of the same medium class, provided for under the 1928 Estimates, are in the earliest stage of construction at Portsmouth and Devonport respectively. Finally, the Estimates for the current year provide for three cruisers—two of a new light class, armed with 6in. guns, and the third of a type not yet decided upon. These three ships would not, in any case, be ordered until the financial year was well advanced. Thus the present position is that we have ten cruisers being completed, being built, and projected, these being vessels of the type most likely to be affected by any new scheme of naval retrenchment. Of smaller craft we have in hand or projected twenty-seven flotilla leaders and destroyers and eighteen submarines, the majority of which are being or will be constructed in private shipyards. It is scarcely necessary to say that the progress of any future negotiations on naval disarmament will be followed with keen interest by the British shipbuilding and allied industries, which have already been gravely affected by the general policy of naval limitation pursued in recent years.

The Lord Privy Seal.

OF the appointments in Mr. MacDonald's new Cabinet one of the most interesting is that of Mr. J. H. Thomas as Lord Privy Seal. In the Labour-Socialist Government of 1924 Mr. Thomas was Secretary of State for the Colonies. His new office is by way of being a sinecure, but it is well known that he has been appointed to it in order that he may be free from the routine work of a department, so that he may devote all his attention to questions of employment and unemployment. Mr. Thomas is, in fact, already being spoken of in certain quarters as the Minister of Employment, and by that title he will probably come to be known colloquially. So far, he has not officially disclosed anything about the steps which he proposes to take in fulfilment of his new duties. From his addresses during the election campaign, however, it can be gathered that among the schemes and plans which he is likely to introduce many will directly affect the country's railway system. It is to be inferred that he will encourage the building of the Channel Tunnel, and the construction of a Greater London railway circle, designed to avoid waste of time and congestion of traffic caused by the carting of goods through London. He also proposes, it is to be gathered, to assist electrification schemes by the reintroduction of the Trade Facilities Act, to deal with the standardisation of running stock and the vexed question of the privately owned wagon, to institute schemes for the reorganisation of the coal-mining industry in order to secure the use of trucks of increased capacity, and to encourage the development of road transport "feeder" schemes to link the agricultural areas with the railways.

Southern Railway Electrification.

IT is announced that the directors of the Southern Railway Company have sanctioned a further expenditure of £597,000 on new extensions to the company's direct-current suburban electric railway system, which it is reported is already the largest of its kind in the world. The new lines to be electrified, which it is hoped will be ready for the summer service of 1930, include a stretch of 27½ miles of track between Hounslow and Whitton Junction to Windsor, 14 miles between Dartford and Gravesend, and eight miles between Wimbledon and West Croydon. Several sub-stations for current supply purposes are to be constructed. On the Wimbledon–Croydon line a new halt is to be made at Waddon Marsh between Beddington Lane Halt and West Croydon, and certain sidings are to be linked up to make an independent goods line between West Croydon and Beddington Lane. When these new extensions are completed the track length of the electrified system will be 800 miles.

Powdered Fuel Steamships.

IN a Journal note of May 31st we referred to the steam collier "Berwindlea," which was recently launched on the Clyde and is to be fitted with pulverised fuel boiler plant. On Friday, June 7th, there was launched from the yard of William Gray and Co., Ltd., West Hartlepool, the steamer "Swiftpool," which is being constructed for Sir R. Ropner and Co., Ltd., and is the first steamer to be equipped with boilers fired on the "Brand" powdered fuel system. The new ship is a modern cargo steamer, built to Lloyd's highest class survey, with a length of 434ft. 4in. and a beam of 54ft. 3in., and a deadweight carrying capacity of 9000 tons. She will be propelled by triple-expansion steam engines, having cylinders 26½in., 44in., and 73in. diameter, with a stroke of 48in. designed to work at a steam pressure of 180 lb. per square inch. The three single-ended boilers will be equipped with the latest type of Brand burners, pulverisers and distributors, and the ship will have a designed speed of about 11 knots. It is of interest to learn that, following the example of the motor ship builders who now style their vessels "M V" instead of "S S," the Brand Company suggests that the prefix "P F S" should in future be used to denote a steamer employing powdered coal as a fuel. It suggests that such a term if once adopted would come to be widely used in the mercantile marine in the course of the next few years.

The Washington Hours Convention.

THE Washington Hours Convention signed in 1919 is an international agreement which specifies an eight-hour day and a forty-eight hour week for all people engaged in industrial undertakings. So far only twelve countries have ratified the Convention, although all told about thirty nations are stated to be actually applying its terms to the regulation of labour within their territories. Great Britain is among the powers which have not as yet ratified the Convention, for in a number of instances great difficulty has been found in agreeing, not to its general principle, but to the exceptions which schedules to the agreement permit each country to make. On Tuesday of this week, however, Mr. Humbert Wolfe, the British Government representative on the International Labour Conference at Geneva, officially announced that His Majesty's Government proposed to take the necessary steps to ensure at the earliest possible moment the ratification of the Convention. He added that the British Government also proposed to ratify in the near future the minimum wages convention and the convention governing seamen's agreements. It is anticipated that the legislation necessary to give effect to these ratification proposals will be introduced in the autumn session of Parliament. The ratification of the Washington Convention will involve a certain amount of readjustment in the agreements in force in some of the country's trading industries. The railways, for instance, have already their own standard day and week. In the engineering industry the standard week of 47½ hours is sometimes covered in five days with Saturday as a holiday. While such an arrangement does not conflict with the principle of a forty-eight hour week, it is clearly in opposition to the eight-hour day specified in the Convention.

The Cascade Tunnel: Great Northern Railway, U.S.A.

No. I.

A TUNNEL, 7·8 miles in length, driven through the hard rock of a mountain range in thirty-seven months, or at the rate of a mile in 4¾ months, is the summarised history of the vary rapid construction of the Cascade Tunnel, which was put in service in January, 1929, by the Great Northern Railway of the United States of America, in order to improve its line to the Pacific Coast. For the tunnel the cost was about £2,800,000, but with 20 miles of reconstruction on the approach and the electrification of 73 miles, the total cost incident to this improvement was about £5,000,000.

This tunnel affords an illustration of the way in which American railways have pushed forward their lines rapidly to develop settlement or to reach sources of traffic, and have then steadily improved them as increasing traffic warranted, for the combined purpose of handling the business more effectively and with higher economy in working expenses. The three successive crossings of the Cascades by the Great Northern Railway are shown in Fig. 1.

When the late Mr. James J. Hill planned the extension of the Great Northern Railway from the central prairie plateau to the Pacific Coast, in order to compete for the increasing trans-Pacific business, his engineers had found a comparatively easy and favourable route through the main range of the Rocky Mountains, but the high and steep range of the Cascade Mountains further west was a difficult problem. Deep snows lie on the range for many months and seriously hamper traffic during the winter season. A tunnel 2¾ miles long was planned for the summit, but the cost, and more especially the time required for its construction, were serious objections.

It was out of the question that the project once decided upon should be delayed to wait for the completion of this relatively long tunnel. However, the engineer, Mr. John F. Stevens, in his explorations, had located an open crossing through a pass—now named the Stevens Pass—at an elevation of 4059ft. above sea level. It was decided, therefore, to build an open switchback line across the range with its summit in this pass. A similar plan had been adopted before by the Northern Pacific Railway, which had a switchback across the Cascades, but further south, for about a year prior to the opening of its own summit tunnel in 1888. This earlier line was 7 miles long, with gradients of 1 in 18 and 1 in 20, and had two reversing stations on each side of the summit.

The Cascade switchback line of the Great Northern Railway, opened in 1892, was 12¼ miles long, although the direct distance was only about three miles—see Figs. 1 and 4. On the east s'ope there were three reversing stations, and the gradients were 1 in 28½ and 1 in 30. On the more precipitous west slopes there were five reversing stations, and the maximum gradients were 1 in 25. Curves were numerous and sharp, many of about 475ft. radius, while two "loop" curves turned angles of 218 deg. and 149 deg. Passenger trains averaging 350 tons made the trip in 1½ hours. Goods trains averaged 700 tons behind the tenders, and at the foot of the switchback two eight-coupled engines were coupled on, one at each end, the train see-sawing back and forth on the zigzag. For clearing the line of snow two engines were coupled back to back, with a steam rotary plough in front of each engine. Heavy trains had to be broken up and taken over in sections of practicable weight. Nevertheless, they *were* taken over and a continuous line of traffic was open, establishing a new railway route.

The First Tunnel.—This open-pass crossing of

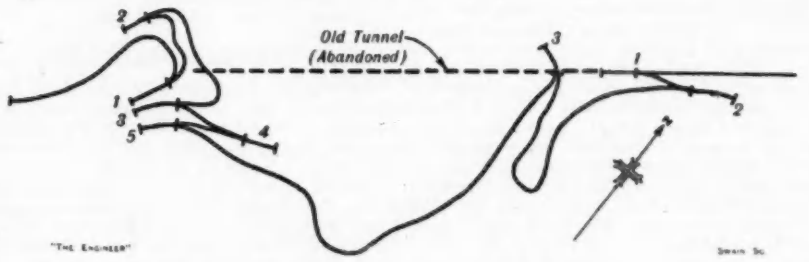


FIG. 4—ENLARGED PLAN OF SWITCHBACK LINES

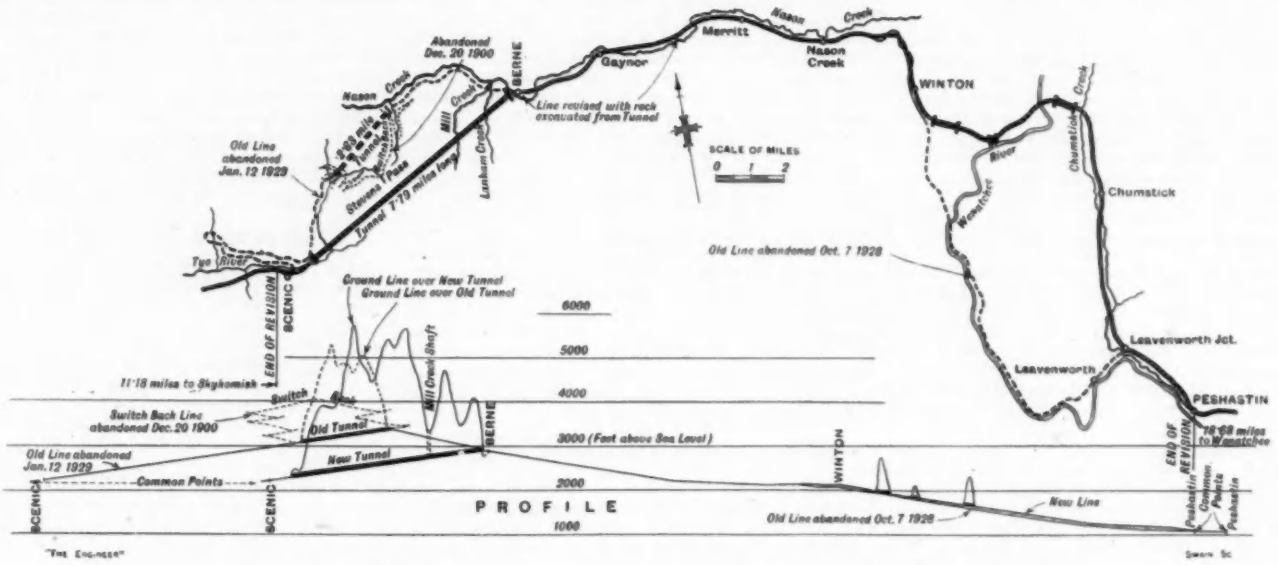


FIG. 1—DIAGRAMS SHOWING THE THREE SUCCESSIVE CROSSINGS OF THE CASCADE MOUNTAINS

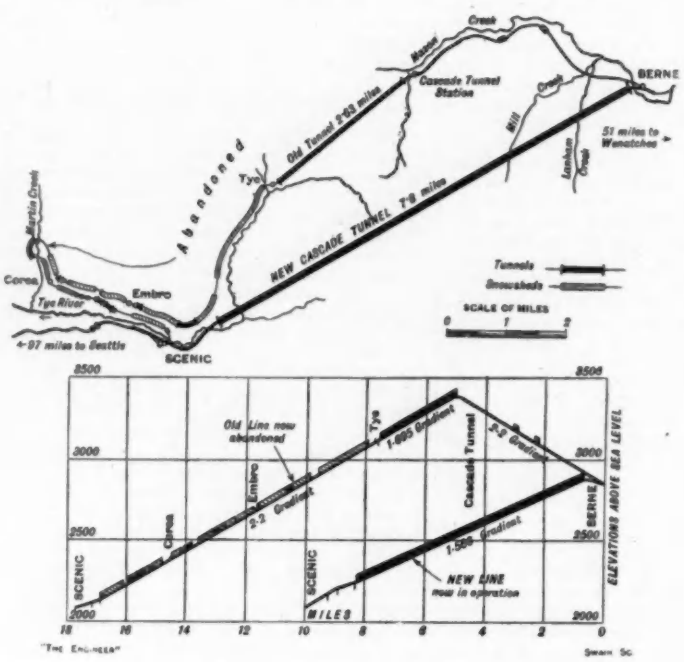


FIG. 2—THE OLD AND NEW TUNNELS

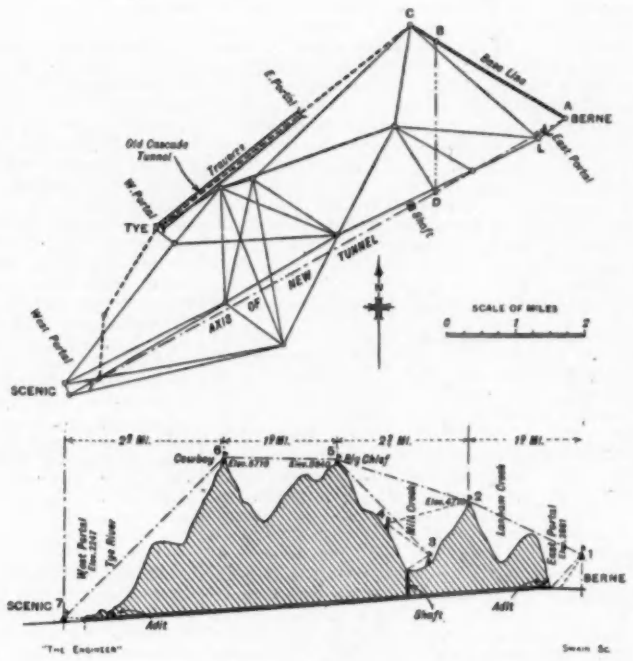


FIG. 3—TUNNEL SURVEY

of curvature, and replaced the 1 in 25 inclines with maximum gradients of 1 in 45, thus enabling the regular trains to pass without being broken up. It also saved about two hours in time.

With this first tunnel line the run between Berne on the east and Scenic on the west side, 17½ miles by rail and 10 miles "as the crow flies," was made in 1 hour 10 minutes by passenger trains and 2 hours 20 minutes by freight trains. Regular eastbound trains of 2600 tons behind the tender—seventy cars—halted at Skyland, 12 miles from the tunnel, where two banking engines were added to work the train over the long gradient of 1 in 45 with its numerous curves. One engine was placed in the middle of the train and the other at the rear. The total weight of train was then about 3250 tons. After electric traction had been installed for the tunnel, in 1909, the banking engines were detached and electric locomotives coupled on to the train engine, but it was often necessary to work steam on the train engine in order to start the heavy load.

The Snowsheds.—On this mountain crossing there are numerous snowsheds, some of concrete and others of timber. These snowsheds serve two purposes:—First, to prevent the line from being buried in deep snow; and secondly, to carry across the line the destructive snow slides or avalanches consisting of great masses of snow, rocks and trees, which come down the steep mountain slopes at certain dangerous places. In 1910, such a slide caught two or three trains which had been pulled up by snow on the west approach to the old tunnel and swept them down into the valley, with the loss of nearly 100 lives. To provide such protection, the roof of the snowshed is sloped about 1 on 5, and this slope is continued on the uphill side until it meets the natural surface above the cutting. Beyond the railway this roof or incline is supported by posts and cribbing, well braced both transversely and longitudinally. This arrangement has been found very satisfactory, and the artificial slope soon becomes more or less covered by a protective layer of *débris* that came down the mountain.

In 1910 there were seventeen snowsheds with an aggregate length of 7395ft., but on account of the increasing snowfall and slides, twenty-six more of 5410ft. were added, making a total of 13,005ft. Some of the new ones were of reinforced concrete, having on the uphill side a massive retaining wall, behind which was placed a filling of earth and rock to fill the space between the cutting and the roof of the shed. At some points also, the line was thrown back into tunnels instead of passing around rocky spurs in open cutting. Or it was covered by a concrete arch or "tunnel" over which material was filled and dressed to a slope of 1 to 5, extending back to the mountain side.

FIG. 5—EAST PORTAL OF NEW TUNNEL, WITH SURVEY LINE CUT THROUGH FOREST

These snow troubles were principally on the west approach, in a distance of 12 miles from Scenic to the old Cascade Tunnel, on which the tunnels and snowsheds had an aggregate length of 9 to 10 miles, all for a double-line railway. From the west portal of the Cascade Tunnel the line ran about 3½ miles west along the slope, then turned a half-circle loop in a tunnel and continued back easterly along the same slope at a lower elevation for three miles, the plan resembling a crooked hair pin. It then turned another half-circle, crossed the river and continued west along the opposite side of the valley to Scenic, the entire distance being on a gradient of 1 in 45. This stretch above Scenic—shown in Fig. 2—is now abandoned. Besides representing a large investment cost, the snowsheds involved a maintenance, repair and fire protection cost of £60,000 to £80,000 annually. In addition, there was the investment, operating and maintenance cost for clearing snow from the open parts of the line by powerful rotary snow ploughs, this service costing from £8000 to £12,000 annually, according to the extent of snowfall. The working expenses were also excessively large.

With such conditions of gradients, curvature, snowfall and avalanches, the great value of a still lower crossing became increasingly apparent, both from the economic and the practical or working points of view. Taken altogether, it was estimated that a new tunnel line at a lower elevation, as now built would effect a saving of about £280,000 annually.

The Second Tunnel.—The difficulties, delays and expenses became more serious as traffic continually increased, and, about twelve years after the opening of the first tunnel line, the engineers began a study for still further lowering the line, with easier gradients and with avoidance of snow troubles. Such an improvement, of course, necessitated a much longer tunnel. All such projects were interrupted by the World War, but in 1925 the studies were renewed and several alternative routes were surveyed. One of these lines was finally adopted. The contract for its construction was let in November of that year, and the line was opened for traffic in January, 1929. This line has a length of about 10 miles, with a tunnel 7·8 miles long, the open extensions connecting the tunnel with the main line being only ¾ mile at the east end and 1½ miles at the west end. The maximum gradient is 1 in 64, and is continuous through the tunnel, descending from the east to the west portal.

In Fig. 1 are shown the three successive crossings of the Cascade Range; the switchback line of 1892; the 2¾-mile tunnel of 1900; and the 7·8-mile tunnel of 1929. A comparison of the two tunnel lines and their characteristics is shown in Fig. 2, and also in the following table. An idea of the topographic conditions is given by the three half-tone engravings. Fig. 5 shows the east portal and the survey line cleared over the first and lowest ridge of the mountain range. Fig. 6 shows the west portal and contractor's camp, the dotted white line indicating the position of the tunnel. In Fig. 7 is the camp at the intermediate working shaft in the Mill Creek Valley, with the white spoil banks of excavated rock conspicuous in the foreground. Here also the route of the tunnel is shown by a white dotted line.

Crossing of the Cascades: Berne to Scenic, Great Northern Railway, U.S.A.

	New line.	Old line.
Length	10 miles	17·66 miles
Maximum gradient	1 in 45	1 in 45
Length of maximum gradient	¾ mile	14 miles
Gradient in tunnel	1 in 65	1 in 58
Sharpest curves, radius	955ft.	573ft.
Total curvature	187 deg.	2128 deg.
Summit elevation	2881ft.	3382ft.
Total rise, westward	45ft.	546ft.
Total fall, westward	824ft.	1325ft.
Length of summit tunnel	7·8 miles	2·6 miles
Tunnels, total length	7·8 miles	3·6 miles
Snow sheds, total length	None	6·4 miles
Bridges, total length	0·04 mile	0·25 mile

Advantages resulting from the new line have been summarised as follows:—First, elimination of trouble from snow slides; second, elimination of more than 6 miles of snow sheds, which required heavy annual expenditures for upkeep and renewal; third, reduction of working expenses incidental to removal of snow on open parts of the line; fourth, elimination of 1941 deg. of curvature, or more than five complete circles; fifth, reduction of sharpest curves from 573ft. to 955ft. radius; sixth, reduction of length of maximum gradient from 14 miles to ¾ mile; seventh, summit elevation reduced by 501ft., with corresponding reduction in rise and fall for all trains.

FIG. 6—WEST PORTAL AND CONTRACTOR'S CAMP

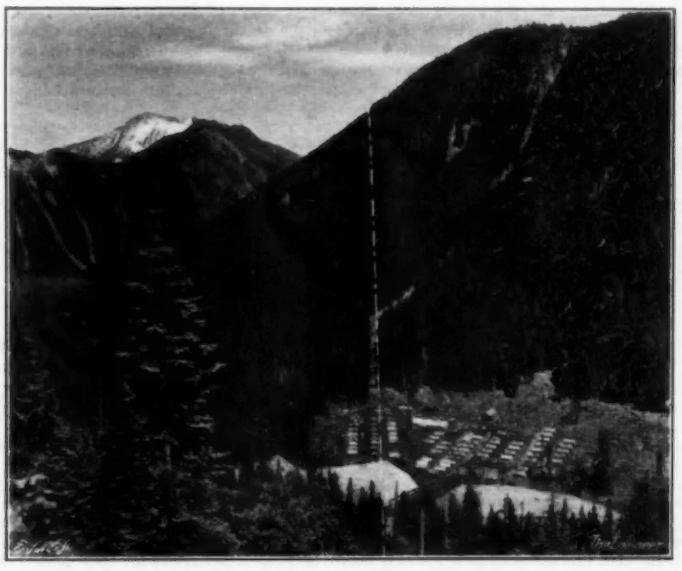


FIG. 7—MILL CREEK VALLEY SHAFT AND CONTRACTOR'S CAMP

Surveys for the Tunnel.—From the preliminary surveys of alternative lines it was evident that on the line adopted for the tunnel there were four main peaks of successively increasing height westward, while at 2·40 miles from the east portal there was the valley of Mill Creek at such an elevation as to permit the sinking of an intermediate working shaft. Accurate

surveys were now necessary, and the following particulars of them are condensed from a description given by Mr. Frederick Mears, assistant chief engineer of the Great Northern Railway, who was in direct charge of the work for the new line. Mr. J. R. W. Davis is chief engineer of the railway, and Mr. M. J. C. Andrews was resident engineer on the tunnel construction.

Sites for the portals were determined by preliminary surveys, with a traverse which mainly followed the existing line and through the old tunnel. Surveys for the tunnel included three principal features: first, establishing the centre line across the mountains and down into the Mill Creek Valley to locate the shaft; second, measuring the length of centre line between portals, on the formation level of the tunnel and determining the position of the shaft; third, determining the exact elevations at the east and west portals and at the bottom of the shaft.

The first survey of the centre line between portals was carried over the mountains in December, 1925. Some of the observation stations were nearly 6000ft. above sea level, with obstacles due to snow and high winds. Small cabins were built near these stations, as the engineers sometimes had to wait for several days for the degree of visibility necessary for accurate instrument work. All sights were taken at dawn or dusk to avoid refraction from the direct rays of the sun. A more exact survey was then made with larger transit instruments, and concrete monuments were set at seven points, as shown in Fig. 3. In each monument was set a 5ft. length of 6in. cast iron pipe, projecting 3½ft. above the concrete and having its upper end threaded to receive the base-plate for the instrument. Openings in this pipe 3in. wide and 7in. high enabled the engineer to centre the plumb bob over the centre line mark on the concrete. A final precise location was made with a special theodolite having a base threaded to screw upon the cast iron pipe standard, which took the place of the usual portable tripod.

Survey points between the monuments were marked first by brass nails driven in wood stakes. After final adjustment of the centre line, concrete blocks topped with brass plates on which the exact point was finally marked with a punch, were set. With the centre line thus established, it was extended beyond the portals and marked by concrete monuments, from which the working line was produced back into the tunnel headings from the portals. To transfer the centre line down the shaft, two piano wires were suspended, 19ft. apart, being steadied by 60 lb. weights, immersed in tubs of water. From this 19ft. base line the tunnel line was extended into the headings driven east and west from the shaft.

To measure the distance between the portals and from each portal to the shaft a precise traverse was made between points established on the centre line. This traverse consisted of four legs, one of which passed through the old tunnel, and the first leg served as a base line for the triangulation shown in Fig. 3, the first triangle being that marked A C L. To insure accuracy in determining the distance of the shaft from the base line, an independent survey, which served also as a check upon the tunnel survey was made. For this purpose the first triangle was A B D, the point B being on the base line A C, and the point D on the surveyed centre line of the tunnel. The solution of this triangle gave the length of the side A D, to which was added the measured distance from D to the selected position of the shaft.

Finally, to determine the gradient, precise levels were run, giving the exact elevations at the portals and the top of the shaft. The depth to formation level was calculated as 622ft., and this distance was measured carefully down the side walls of the shaft. With careful survey work in the headings, the errors at the meeting point in the tunnel between the west portal and the shaft were 0·64ft. in line, 0·78ft. in elevation, and 1ft. in distance. For the shorter length between the shaft and the east portal, the errors where the headings met were 0·23ft. in line, 0·20ft. in elevation, and 0·9ft. in distance.

FIG. 8—INTERIOR OF PIONEER TUNNEL, WITH CROSS-CUT TO MAIN TUNNEL ON THE LEFT

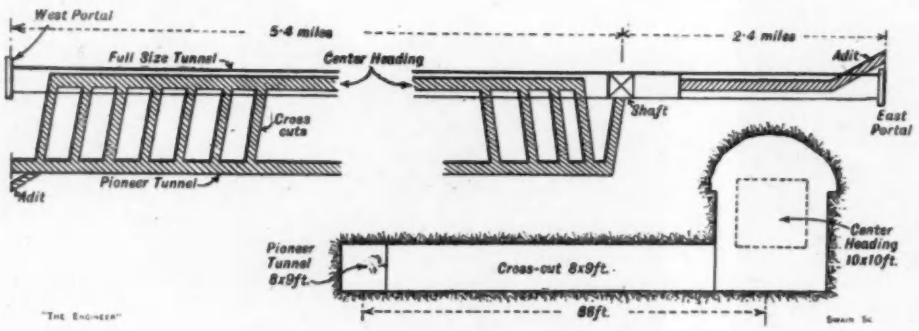


FIG. 9—SCHEME OF TUNNEL CONSTRUCTION

Method of Tunnel Construction.—After a thorough study of the topographic, geologic and other conditions, and in view of the demand for rapid construction, an unusual combination of methods was adopted by the contractors. It was decided to drive a pioneer tunnel from the west end, parallel with and 66ft. to the south of the main or railway tunnel, with lateral drifts or cross-cuts to the centre line of the latter. In this way numerous headings could be started and work driven in both directions from these points, using the pioneer tunnel for a haulage way and for placing the numerous pipes and conduits.

It has been said by Mr. Baxter, of the contracting company, that selection of the distance between centre lines of the main and pioneer tunnels—66ft.—was based on the judgment of the thickness of intervening rib necessary to prevent its crushing by the superincumbent load. In the first Simplon Tunnel this distance was 56ft., but the rib failed at several points by crushing.

In Fig. 8 is shown a view in the pioneer tunnel, at the right, with a cross-cut to the main tunnel diverging to the left. In this cross-cut is the big ventilation pipe. The general construction scheme, with the arrangement of the tunnels, cross-cuts and shaft, is shown in Fig. 9.

From the Mill Creek shaft the headings of the main tunnel were driven both east and west. But the distance from the shaft to the east portal—2·4 miles—was too short to make it worth while to drive a pioneer tunnel. From the shaft a drift was run to the centre line of the pioneer tunnel and then this tunnel was driven westward. Thus, the pioneer tunnel extended only from the west end to the shaft. Besides enabling many headings to be started for the main tunnel, this pioneer tunnel served to carry the construction railway for handling men and supplies and removing the excavated rock. It also served to drain the main tunnel, and in it were laid the ventilating pipes, compressed air pipes and the electric lines for power and lighting.

On November 26th, 1925, the Great Northern Railway Company let the contract for the construction of the tunnel to Guthrie and Company, the Vice-President of which, Mr. J. C. Baxter, took direct charge of the work. Mr. R. F. Hoffmark was general superintendent, and on his promotion he was succeeded by Mr. W. E. Conroy. The contract required completion of the tunnel in three years. In spite of difficulties this was accomplished, the tunnel being completed on December 24th, 1928, three days ahead of time. After clearing up the work, ballasting and laying the track and installing the electric haulage and signal systems, the formal opening took place on January 12th, 1929.

Clearing sites for the contractor's camps began December 1st, 1925, at the west end, and December 4th at the east end. On December 14th work began on the approach to the pioneer tunnel; December 17th on a road to the site of the shaft; December 28th on the heading for the west end of the pioneer tunnel; January 30th, 1926, on the sinking of the shaft; and February 8th on the main heading at the east portal. This prompt action was necessary in view of the short time, even if no serious interruptions or emergencies occurred. To assist in the speed of progress, a chart or schedule, showing the stage which it would be necessary for each part of the work to reach each month in order to have it all completed in time, was prepared. This schedule included the shaft, the pioneer and main headings, the enlargement to full section and the concrete lining.

(To be continued.)

Incorporated Municipal Electrical Association.

No. II.*

THE discussion on Mr. Rothwell's paper, read on the morning of Wednesday, June 5th—abstracted in our last issue—indicated a consensus of opinion in favour of the need for consolidating legislation relating to the electrical industry. The position arising out of the Manchester Corporation case is causing grave concern among those responsible for the ever-increasing size of our power stations, and there is a fear that unless some special legislation is introduced, the size of such stations will be curtailed. Even if the result of the appeal to the House of Lords may be satisfactory in the Manchester case, there are those who hold the view that public opinion having been stirred in the manner it has been will be sufficiently strong to force governmental action. Therefore, the great desire is to have the operation of these large power stations—subject, of course, to negligence being proved—placed in an unassailable position.

Apart from that aspect of legislation as applying to electricity supply, a large number of other matters were brought forward indicating the urgent necessity for co-ordination and consolidation. Most of them are matters of detail which an endeavour was made to introduce into the Electricity Supply Act of 1926, but the Ministry of Transport objected on the ground that that measure had been drafted for one specific purpose. Difficulties are being encountered in regard to the construction of transformer chambers and sub-stations, the mere fact that a Corporation has been authorised to supply electricity not giving the power to construct such premises, special powers having to be sought. Again, troubles have arisen concerning by-laws relating to installation work, and it has been found that in the case of a new consumer, even where such by-laws can be made, it is necessary to connect up with the supply and then cut it off immediately if the by-laws have not been complied with. This, of course, is a matter of the drafting of the clause authorising by-laws, but, again, unless they are made enforceable by the Electricity Commissioners, it appears that nothing can be done. It is common knowledge, also, that two-part tariffs cannot be forced upon consumers as the law stands at present, whilst further difficulty has arisen in deciding who is responsible for money placed in slot meters on consumers' pre-

* No. I. appeared June 7th.

mises in the event of it being subsequently stolen. These are but a few of the points that are concerning those who desire to see the business of electricity supply run on really commercial lines.

The outstanding point made in the discussion, perhaps, was the suggestion by Mr. W. M. Selvey that there must be formed one organisation consisting of representatives of the I.M.E.A. and the power companies, the British Electrical and Allied Manufacturers' Association, the Cable Makers' Association, and the Electrical Contractors' Association, which would be in a position to speak nationally to the Government and to formulate such codified form of legislation as should hold a true balance between itself and those other interests with which it comes into contact. Such a body, however, added Mr. Selvey, would obviously have to deal first with harmonising the internal conditions of the industry. Although he foresaw that such a development as he had outlined might not be to the liking of everybody, he believed it was inevitable.

HEAVY OIL ENGINES FOR ELECTRICITY SUPPLY.

The only engineering paper presented to the Convention was read on Wednesday afternoon, June 5th, and dealt with the heavy oil engine and its application in electricity supply undertakings. The author was Mr. Geoffrey Porter, borough electrical engineer at Worthing, and as no paper on this subject had been contributed since 1911, it followed that there was a good deal to say that was new. The author is a strong advocate of the use of heavy oil engines in connection with electricity supply, although he realises that under the conditions of generation that will apply when the Government scheme becomes fully operative, there will not be much scope for such engines for primary generation purposes. He emphasises, however, their scope for peak load service, and mentions a number of places on the Continent where they are used to good purpose in that way. For instance, the City of Hamburg has a 15,000 B.H.P. two-stroke double-acting heavy oil engine, coupled to a 10,000-kW alternator at its Neuhof power station, which also occasionally serves for base load purposes, should one of the base load units be out of commission. The management in this case considers that the addition of a further 20,000 kW to 30,000 kW of heavy oil engine generating plant would still further improve performance by permitting better co-operation between the Neuhof and the other power stations of the city. The thermal efficiency of the 15,000 B.H.P. engine at 95 per cent. of the gross loading is claimed to be some 59 per cent. better than that of a steam turbo-alternator equipment with its attendant steam raising, condensing and auxiliary arrangements designed to capture the last B.Th.U., assuming a 10,000 B.Th.U. coal burned at the overall rate of 1·5 lb. per kilowatt hour.

The paper enumerates the characteristics of the various types of heavy oil engine now available, and makes special reference to the system of supercharging devised by Mr. A. Büchi, which was described in a paper before the World Power Conference in 1928. By its means an engine, after undergoing inexpensive alterations of cam and valve settings, may be safely overloaded continuously by 50 per cent. of the normal maximum rated power and by 100 per cent. for short periods. Inversely, Dr. Büchi's system enables a smaller—supercharged—engine to perform the work of a larger—unsupercharged—engine, and thereby effects a reduction in first cost. Several engines to operate on this system are now under construction, and some are at work. In Mr. Porter's opinion, Mr. Büchi has made a very important contribution to the development of the heavy oil engine in its Diesel form.

Discussing the results obtained in connection with electricity supply by the adoption of the heavy oil engine in its various forms, the paper points out that in 1928 there were fifty-one generating stations throughout the world using heavy oil engines, according to the returns prepared by the Diesel Engine Users Association, of which thirty-eight were in Great Britain. The largest output of any one of them was 10,564,390 units, and the smallest 23,313 units. The combined total of the thirty-eight British stations was 47,940,648 units generated under varied conditions of load factor, engine type and price of necessary commodities, the figures showing average costs for fuel, oil, water, and stores, wages and repairs, and maintenance, of 0·692d. per unit. An analysis is also given of the average fuel consumption, thermal efficiency and fuel costs of twenty-three stations equipped with engines varying in age between nineteen years and one year, operated over a wide range of load factors. The majority of the engines are of the air injection type, but as a general conclusion it is pointed out that the airless injection engine is, in practice, about 2 per cent. more efficient and correspondingly cheaper in fuel cost than the air injection engine of the same capacity. The figures are taken from actual practice and not from test bed results. Official trials suggest a difference in efficiency between the air and airless injection types of about 8 per cent., corresponding closely to the power absorbed by the air compressor. The airless injection engine benefits also by the absence of the cooling effect of the blast air upon the combustion chamber contents at injection.

In analysing heavy oil engine station costs, the Diesel Engine Users Association has noticed an interesting fact relating to the position taken by a set of engines about twenty years old. These engines achieved the lowest average rate of fuel consumption per kilowatt-hour in a list of 138 engines. That so low a fuel consumption as 0·665 lb. per kilowatt-hour should be attained in the twentieth year of an engine is commented upon. Another definite conclusion drawn from the analyses that are issued annually by the Diesel Engine Users Association is that the cost of repairs and maintenance is low, and shows little tendency to increase. Therefore one of the popular objections to the heavy oil engine—viz., its alleged costly repair bill—is not borne out by actual practice.

Speaking of the future of electricity supply in this country, it is suggested that the bulk supply prices that have so far been arranged by the Central Electricity Board do not compare with what has been and can be attained by the use of the heavy oil engines in some of the non-selected stations; moreover, with increasing output the standing charges of the "oil" stations tend steadily to fall, so that the position of many of them, good as it is to-day, contains the prospect of even better results were local generation to continue. Whilst it is admitted that the present temporary rates of the Central Board for bulk supply may be very different from the permanent rates, it is at the same time pointed out that rates of the order of £3 per kilowatt and ·25d. or ·30d. per kilowatt-hour are too high to benefit a well-established heavy oil engine generating station where extensions of similar plant can be effected. In units up to 1000 kW capacity an extension of oil engine generating plant can be carried out for an annual capital charge of about 30s. per kilowatt—interest and repayment being calculated at 5 per cent. for the normal periods as a simple annuity. Similarly, it is suggested that the rates which local undertakings are likely to be charged under the Government scheme will not be sufficiently low to enable them to compete with individual oil engine stations erected by large commercial users, seeing that such users are given the benefit of the Government rating scheme, whereas public supply undertakings are not.

There was a long and interesting discussion on the paper.

Mr. Mellor (Fraser and Chalmers, Ltd.) did not agree with the author that the oil engine in this country had languished under the shadow of progress in steam turbines. On the contrary, he claimed that steam turbine designers had been spurred to valiant efforts to maintain relative progress in overall thermal efficiency and generating cost per unit with that which the modern oil engine can give. Progress in metallurgy had reduced the cost of maintenance considerably, and to-day it was possible to give a definite assurance that thermal and mechanical efficiency will remain at a higher level than with any other prime mover over a given number of years. With a steam turbine installation, the efficiency decreased as wear and tear on nozzles and blades took place. It had always puzzled him why large electrical undertakings had not been the foremost users of heavy oil engines, which had proved to be the most economical heat prime mover known to industry. It might be a surprise to many to know that in London over 10,000 B.H.P. in oil engine plant was provided specially to deal with peak load and to supply special theatre mains, which, owing to London County Council by-laws, were entirely separate from the ordinary supply. In an underground space situated in the West End of London there was an oil engine power station capable at present of dealing with 5000 kW, and eventually with 7000 kW for the special service mentioned above. That space was 120ft. long, 36ft. wide and 21ft. high. Dealing with the relative costs of steam and oil plant, Mr. Mellor suggested that the author was very high with his cost for oil engines and generators. It was possible to-day to buy oil engines at £7·5 per B.H.P., and suitable alternators at £2·5 per kilowatt, and for a station of 20,000 kW, seven oil engines of 4200 B.H.P. each could be bought for £220,000 and seven alternators of 3000 kW each could be bought for £53,000, or a total of £300,000, adding 10 per cent. for contingencies on the engines. Recently he had to prepare a complete scheme in detail for a 12,500-kW (maximum) oil engine station, with an output of 50,000,000 units, which represented a 57 per cent. load factor on an output of 10,000 kW. The capital cost of five engines and alternators, together with full station equipment, foundations, buildings, cranes, and storage tanks, amounted to £239,000, and the total running costs were estimated at ·301d. per unit generated. It was very difficult to arrive at a figure for rates, taxes, depreciation, profit, &c., but eventually he computed it at £75,000, which brought the running costs up to 0·65d. per unit. He regarded his estimate as high, and if fuel could be purchased at £3 per ton—which was not unlikely—the figure would be something below 0·6d. per unit, which compared favourably with the best steam stations. Whilst pulverised fuel was lessening the cost of coal for electrical generation, parallel efforts were being made to reduce the cost of fuel oil, and in matters relating to the hydrogenation of coal and low-temperature carbonisation for the production of oil this country was not lagging behind others. Surely the Commissioners could, without lessening their patriotism towards coal, delve more sympathetically into the economical status of the large oil engine power station, either for bulk supply, peak load or standby. They would find no engineering reasons to excuse their neglect of the oil engine; furthermore, they would find throughout the country many centres which could be provided with power at a lower cost than that quoted by the author, viz., £3 per kilowatt and ·25d. per kilowatt-hour. The Electricity Commissioners were the servants of the public, and it was their duty to perform their function by thoroughly investigating whether large oil engine stations could be efficiently used for public service. There were 25,000 employees in that industry, and in a national scheme like the electricity scheme of the Government they deserved similar considerations to that which had automatically fallen to the lot of their steam turbine colleagues. The Government and the Electricity Commissioners would be doing a national service if they asked for the co-operation of oil engine manufacturers by inviting them to build units which would never betray the national service to which the Commissioners themselves were committed.

Mr. I. V. Robinson (B.E.A.M.A.) said nobody would suggest that it was possible to put down an oil engine plant of the same capacity as cheaply as a steam plant. The efficiency of oil engines, however, was better, and Mr. Porter did not claim as much credit for that as he would have expected him to do, but the great desideratum was the reduction of capital costs, and the paper held out some hope in that direction, because, in referring to high-speed plant, it was stated that high-speed oil engines could be sold at about 60 per cent. of the price of slow-speed engines. That would bring the working costs to about the same as those of steam plant, and it appeared to him therefore that the future of the internal combustion engine was based upon the high-speed engine and some form of supercharging. At the same time, there was no reason why the ratio of maximum rating to normal rating of steam turbines should be fixed at 25 per cent., which was usual. As a matter of fact, at the Hellgate station in New York there was turbine plant of 80,000 kW to 90,000 kW normal rating which had a maximum rating of 160,000 kW for a short period.

Mr. Maximilian Gercke (M.A.N. Company) said that the proposal to use steam at base load stations and to have local Diesel installations as standby and phase-rectifying sets, had been applied with remarkable success in some continental districts, and the Hamburg station had thus saved some 5000 tons of coal in the last winter season, in addition to saving the situation on several occasions when the supply was threatened with interference through ice troubles in the condensers of the steam installation. There were great possibilities of developing the heavy oil engine in Great Britain by using coal tar products for Diesel engines. Thus the fuel used for the oil engines would be a national fuel, just as coal was.

Mr. J. Christie (engineer and manager, Brighton) said Mr. Porter would not be allowed to extend his oil engine station, and under the grid system would have to take his additional power in bulk from the Southwick station of the Brighton Corporation, the peaks being met by running up the very efficient Diesel plant at Worthing, as and when required. The author had made out a most excellent case for Diesel engines, and their more extended use as emergency and peak-load spares, even on a big scale, for use in connection with super-power stations supplying the national grid system. In connection with the high-tension supply in Palestine and around Jerusalem from the hydro-electric scheme now under construction, Diesel engine driven sub-stations were being used for developing the demand in the outlying areas pending the construction of the high-tension transmission lines with static sub-stations. When such stations as those of the author were shut down, he suggested that the highly efficient plant might be utilised by the Central Electricity Board for developing the demand in the outlying areas in this country until the demand justified the heavy capital expenditure of extending the grid.

Mr. H. W. Watts (borough electrical engineer, Epsom) said that for power station work the dice had been loaded against the Diesel engine by the very short loan repayment period allowed, and now sanction to extend such plants was withheld altogether. Yet, with its higher thermal efficiency, the Diesel engine was a serious competitor to the very best steam plant. It was a debatable question as to whether it would prove economical to transmit electrical energy over long distances to meet the peaks, and it became a question of what type of plant would efficiently generate the energy required at a point as close as possible to where it would be required. The Diesel engine, being better in thermal efficiency than up-to-date steam plant, was definitely suitable for that purpose. New plant could be installed for £11 per kilowatt and at 8 per cent. interest and depreciation, that worked out roughly at £1 per annum, whereas bulk supply authorities found it necessary to charge often considerably over £4 per kilowatt of maximum demand. Hence there would be considerable saving with Diesel plant. He had received quotations from British manufacturers of Diesel engines for a 5000-kW set for £11 per kilowatt, and had been offered a figure of consumption of 0·47 lb.of fuel per unit, which was lower than any given in the paper. Mr. Watts suggested that the author had been too optimistic

as regards his figures of steam fuel costs. There was not a steam station in the South of England which could give the costs set out in the paper, not even Barking with its thermal efficiency of 19·45 per cent. On the other hand, at Epsom he himself was getting the oil fuel costs mentioned in the paper, and any heavy oil engine plant should easily get such results. He asked all station engineers with steam plant, and particularly those who will have the control of selected stations, to consider very carefully the use of oil engines for taking care of the peak loads.

Mr. C. M. Johnstone (engineer, Shrewsbury) pointed out that the paper seemed to suggest that above a speed of 250 r.p.m. the author would advise the adoption of very high speeds of rotation, and excluded the possibility of the satisfactory performance of engines running at something between the two speeds and specially designed for central station work. In 1923 there were installed at Shrewsbury two slow-speed engines of 250 H.P. each, which had given every satisfaction, and in 1927 and 1928 two six-cylinder 600 H.P. sets, which had given excellent results running at 350 r.p.m., were added. Those two engines were of the four-stroke type with air injection. The bore and stroke were 15in. and 17in. respectively, and the mean effective pressure on full load was 93 lb. per square inch. The compression pressure was 460 lb. per square inch and the firing pressure 500 lb. The piston speed was 990ft. per minute. The compressor was incorporated in the engine and mounted in line with the cylinders at the end remote from the generator. Several sets had been supplied or were in course of construction. The generating costs at Shrewsbury with an output of 2,322,340 units, an annual load factor of 28·5 per cent., a running plant load factor of 66·07 per cent., and a fuel price of 93s. 3d. per ton, were ·569d. per unit, and owing to these low costs the Shrewsbury Corporation was able to sell energy at rates which were among the lowest in the country. With well-balanced six-cylinder engines, there was no need to fear vibration troubles, and, as at Shrewsbury, it was possible to have the power station alongside public buildings and residences.

Mr. Bertram Kelly (Douglas, I.O.M.) said that in his power station last year four heavy oil engines generated 2½ million units at a cost for fuel, oil and water, &c., of ·39d. per unit generated. The fuel consumption was ·92 lb. of furnace oil per unit generated at 75s. per ton, and the cost worked out at ·286d. per unit generated, which was as good as the very best example quoted in the paper. Neither the Electricity Commissioners nor the Central Board had any jurisdiction in the Isle of Man, but very shortly his station would develop into a capital station in a small way for supplying the whole of the island, an area of about 200 square miles. There would be several sets of 4000 kW capacity, and although it was contemplated to put down a steam station, he intended to use Diesel engines in conjunction with the steam plant.

Mr. H. L. Howard (Macclesfield Electricity Supply Company), as an advocate of the heavy oil engine, said that the most important point was the question of fuel. Mr. Gercke had mentioned tar oil, but in this country, owing to the demands for road purposes, there was no surplus of tar sufficient to warrant the large gas undertakings putting down plant for proper distillation. He had a large number of Diesel engines, some of them fifteen years old, but they were all doing consistently good service, day in and day out, and were as efficient as the day they were put in, the secret being careful and efficient maintenance.

It was intimated that Mr. Porter would reply in writing.

Electricity Tariffs.

On Thursday, June 6th, Mr. E. J. Jennings (secretary, Birmingham electricity undertaking) read a paper, entitled "Standardisation of Methods of Charge: Some Thoughts and Considerations," from which we take the following conclusions :—

(1) Standardisation of methods of charge is desirable in the larger interests of the industry.

(*a*) Because, in future, practically all electricity supply undertakers will themselves be purchasing bulk supplies on a "common" basis, even though rates themselves may differ owing to differing conditions;

(*b*) Because it will avoid confusing consumers who move from one area to another if a system of charge is universal throughout the country, as in the case of the telephone service.

(2) Equity and experience alike call for the general adoption of a two-part tariff, with possible two-rate meters in certain cases. Any tariff adopted must be sufficiently elastic to permit and encourage freely a policy of filling in the "valleys" in the demand curve.

(3) With regard to the basis for assessing the primary charge to cover standing costs, no universal standard capable of meeting all requirements has yet been evolved, but, as nearly as may be, this should be related to the size of the building and the character of its use—*e.g.*, domestic or commercial—and, in the case of industrial supplies, it should be on the actual maximum demand.

(4) In any tariff or method of charge adopted, every unit or output should bear some contribution, but not necessarily the same percentage contribution, towards fixed or standing costs.

(5) The difficulty of dealing with large undertakings developed on the basis of graduated flat rates should be met by the offer of alternative attractive tariffs of a two-part character, and a process of gradual change over. Consumers should be given the option for a limited period of either two-part tariff or flat-rate system, and reductions of charges should in future be confined to the two-part tariff rates.

The discussion on this paper was almost unanimously in favour of two-part tariffs, although Mr. J. Christie, the borough electrical engineer at Brighton, where the maximum demand was originally introduced, but was abandoned twenty-one years ago, stood out whole-heartedly for flat rates. Doubts were expressed by some speakers, however, as to standardisation at the present stage.

At the annual dinner of the Association, which was held on Thursday, June 6th, Sir John Snell, Chief Electricity Commissioner, who was the principal guest, indicated that the next problem which must be undertaken by the Electricity Commissioners was the co-ordination of distribution, on the lines suggested in the presidential address, a matter, he added, which the Commissioners had been working at in a small way ever since they took office ten years ago.

Laboratory Methods of Research in Hydraulics.

By L. U. MALZ, of the Central Asian Institute of Waterworks Engineering Research, Tashkent, U.S.S.R.

Laboratory methods of solving certain problems in a number of different branches of science are becoming increasingly important, and often not without reason occupy a position of supreme importance.

It frequently happens that the experimental study of a problem by direct methods serves as an aid and guide to its theoretical solution. Often a problem, that does not lend itself to solution by analytical methods, may be solved readily by means of a properly arranged experiment.

Sometimes a problem becomes extremely complicated because its solution is a function of many variables, most of which it is difficult or even impossible to take into account. In such instances the solution is, at the best, that of one or more equations containing a large number of unknown terms. By means of an experiment, performed under certain definite conditions, some of the variables are eliminated, which leads to a partial solution of the problem, that in many instances is quite sufficient. The enormous strides which have been made in some of the more intricate branches of human knowledge are due entirely to the use of experimental methods of investigation. As an illustration, reference need only be made to the progress and rate of development in the branches of science relating, for instance, to aerial communication, to the transmission of sound and pictures by wireless, and to a host of other ideas of the human mind, which, some twenty years ago, appeared to be mere dreams beyond realisation.

Often, in the case of a problem which may be solved, but with some difficulty, by analytical methods, experimental methods, if they result in a saving of time and labour, may prove successful. In this connection, reference may be made to the solution of statically indeterminable systems by means of special models. This method first made its appearance a few years ago, and has of late become very popular.

It is thus easy to understand the growth, in both numbers and importance, of those special institutions, the aim of which is to undertake experimental research on problems arising out of our daily life. The work of these institutions is new in principle and in character, and unlike work which has proceeded for some time, is not based on previous experience, so that it demands special and frequently quite new methods. One of the main difficulties of an experimental investigation lies in the selection of the methods. The writer met with this difficulty in the course of his work in the hydraulics laboratory of the Central Asian Institute, and the object of the present note is to enumerate some experimental methods for solving certain problems in hydraulics.

It must be pointed out that the experimental technique for the solution and investigation of many problems in hydraulics is not, generally speaking, very complicated, and in certain instances may be carried out very easily, with the help of the simplest of apparatus. In view, therefore, of the great importance of experimental methods from the engineer's standpoint, and of the great ease with which, in certain instances, they may be performed, and taking into consideration the almost complete absence of important sources of information on these points, the writer believes that a few hints relating to such methods may prove useful.

A stream of water is characterised by the following magnitudes :—

Position of the free surface (the level of the water).
Discharge.
Velocity of the individual currents and the so-called mean velocity.
Direction of flow of the individual currents.
Form, character and velocity of certain currents of the stream deviating in a marked manner from the general direction of flow of the stream. These are called eddy currents, and their motion is known as eddy current motion.

The magnitude and direction of the velocity of the currents is of interest as regards either the surface of the stream or its entire cross section. In this connection a distinction is drawn between surface velocity, the velocity in different portions of the cross section of the stream, and bottom velocity.

The methods by which the above magnitudes may be determined will now be considered.

Determination of the Level of the Free Surface (for a stream, this is the determination of the position of the free surface). This may be carried out by means of a vertical scale (levelling rod), float gauge, or needle gauge.

The determination of the level of the surface by means of a scale is very simple, but is perhaps the most inaccurate of the three methods. The scale is set up vertically in the stream—Fig. 1—and the level of the water is read off directly. The inaccuracy of the method is due to two causes. The first of these is the alteration of the water level in the proximity of the scale, as compared with that of the rest of the stream. The scale causes a convexity on the surface above stream, and a concavity downstream. The magnitude of the error involved depends upon the velocity of the stream. The second cause of inaccuracy is the liquid meniscus near the surface of the scale, resulting in distorted readings. When the velocity is low, and the surface of the scale is such that the meniscus is sufficiently small, this method gives entire satisfaction in use. Very frequently, in laboratory work, such scales are set up in the tanks supplying water to the models.

The determination of the level by means of a float gauge is based on the principle that the float—Fig. 2—takes up a definite position as regards the surface of the water, and follows the slightest changes in the water level. A pointer connected to the float enables the level to be read off directly. Gauges of this type are called limnographs, and are employed successfully in natural streams and waterworks constructions. Limnographs may also be used in laboratory work, provided the surface velocity is low, otherwise the readings are considerably distorted. A limnograph which has been installed in the hydro-technical laboratory of this Institute to give the level of the water in the tank employed in steadying the flow of water to the hydraulic trough is very accurate, giving a reading to within 0·1 mm.

The needle gauge is an excellent instrument for measuring the position of points on the free surface of any liquid. The needle is prismatic in form, of small cross section, and long, and ends in a point—Fig. 3. Its position is measured in relation to some fixed plane, for which purpose it is mounted on a cross-piece supported on two runners fixed near the model—Fig. 4. By moving the cross-piece, with the needle mounted on it, along the runners, the position of any point on the free surface of the stream may be determined.

All the above methods have the common disadvantage that the appliances employed are somewhat unwieldy. The scale gauge and the float gauge are stationary, and cannot be used everywhere. A certain amount of time—from a few seconds to half a minute—is required in taking a reading by means of the needle gauge, so that the figures obtained do not enable one to form a true opinion of the shape of the free surface, the free surface of a stream not being constant, but continuously changing. Each consecutive reading refers to a different period of time, and consequently to a different position of the free surface. In view of this fact the needle gauge should only be used for streams the free surface of which occupies a more or less fixed position, otherwise inaccurate results are obtained. It will be true that in certain instances a measurement of the highest position of the water level at each point is decided upon, with the view of obtaining the highest position of the free surface. Then by measuring the amplitude of the variation at these points it is possible to form some opinion of the other positions of the free surface. At the same time, however, the chief advantage of the needle gauge, its exceptional simplicity, results in its very frequent use, and in the hands of an expert observer it is very accurate.

Recently a stereoscopic method has been used for measuring the free surface of a stream. Despite its complicated nature, the method has given such satisfactory results that there is every reason to believe that it will occupy the important position it deserves. The principle of the method is briefly as follows :—Our visual perception of the space dimensions of different objects arises from the difference in direction of the rays of light entering each eye. If the object is situated far enough away, the rays of light proceeding from one point and striking each eye differ only slightly in direction, and are almost parallel. If the object is near, the directions of the two sets of rays make a wide angle with each other, and the resulting sensation of distance and space is entirely due to the different impressions received by each eye. This fact is made use of in stereo-photo-

graphy. Two photographs taken by cameras at some distance from each other differ from each other in somewhat the same manner as the images on the retina of the eyes, so that on looking at each photograph with the corresponding eye a relief effect is obtained. The differences in two such photographs fixes the position in space of the photographed object, and is made use of in stereo-photogrammetry, which is a method for determining the position of a point in space from the difference in its images in stereo-photographs.

The technique of the method is as follows :—A photograph of the object under investigation is taken by a stereoscopic camera ; that is to say, two cameras arranged with their optical axes parallel and at a fixed distance apart. The stereo-photograph is then examined by means of a special instrument, called a stereo-comparator, in which the position of points in space is determined from the difference in their positions on the photographs. This method has given excellent results in surveying. It is obvious that the method should be important for studying the free surface of streams both in actual practice and in the laboratory. By taking an instantaneous photograph the momentary position of the free surface of the water may be obtained.* The necessity of taking an ordinary photograph is avoided by suitably arranging the conditions. It is well known that a ray of light is invisible in absolutely pure air and water, but that at the interface between air and water, owing to a partial reflection of the light, the point of incidence of the ray appears illuminated, exactly in the same way that the point of incidence of the ray would be illuminated on an opaque, reflecting body. The rays of light are first sent through a narrow slit, from which they emerge in the form of a narrow pencil—or rather beam—and produce on the illuminated body a line of light, the line of intersection of the "luminous plane" with the body. In practice, the intersection of a surface with a horizontal plane is usually known as a contour, and the intersection with a vertical plane as a profile. The shape of a surface is determined absolutely by a system of contours, or equally by a combination of profiles. Similarly, a system of inclined intersection lines may be employed.

In applying the above method to the present problem, it is possible by causing a narrow beam of light to impinge on the stream, to obtain according to the direction of the beam, contours or profiles determining the surface of the stream, a part of the beam being reflected on striking the surface of the water. These contours or profiles may then be recorded by photographing the trace of the beam on the surface. A trace of this type, produced by a beam of light, is particularly noticeable on opaque, reflecting bodies. Instruments employing this principle are called "profilographs"—Fig. 5—and are widely used on the Continent.† It is intended shortly to install such an instrument in the hydro-technical laboratory of this Institute.

As a further development of the principle, one may picture a source of light emitting not one beam, but a number of beams at equal distances apart. By directing such a system of beams of light on to the surface and photographing it—Fig. 7—a number of profiles of the surface or a contoured plan of the surface may be obtained—of course, after some elaboration. This method is particularly applicable to a study of the free surface of water, and the writer has applied for a—Russian—patent to cover a suitable method and apparatus.

There is another method which, although it does not give directly a complete picture of the free surface of the stream, as does the method just described, requires practically no special apparatus. In principle, it consists in taking a photograph of the stream by means of a stereoscopic camera. The stereo-photograph is examined in a stereoscope, a transparent positive of a given space lattice or grid—Fig. 6—being placed in the stereoscope at the same time. The images are thus superimposed, giving the impression that the grid is entirely submerged in the stream. Of course, this effect is only possible if the correct grid is used. On examining the combined images, the position of important points on the surface of the stream can be determined. Obviously, the method is not confined to laboratory investigations alone, but may be used in other directions. The method, as brought out by the author, is no other than a modification and extension of the principle of the stereoscopic range-finder, as used in special binoculars.

Although the above photographic methods are rather intricate, they possess the advantage of enabling a permanent record to be made of the state of the free surface of a stream at any given moment. Consequently, they are to be preferred, whenever the surface of the water undergoes rapid changes.

The Discharge is measured in modern laboratory practice by the following methods :—

(1) Water meters which take into account the velocity of the water.
(2) Water meters which take into account the level of the water.
(3) Gravimetric and volumetric methods.

In the first of these methods the water is allowed to flow through a pipe. According to Bernoulli's theorem, if the head is constant, the sum of the static and dynamic pressures is constant also. Therefore, by measuring the pressure in the pipe during discharge, and knowing the pressure in the pipe when the water is not flowing, the velocity, and therefore the discharge, can be calculated.

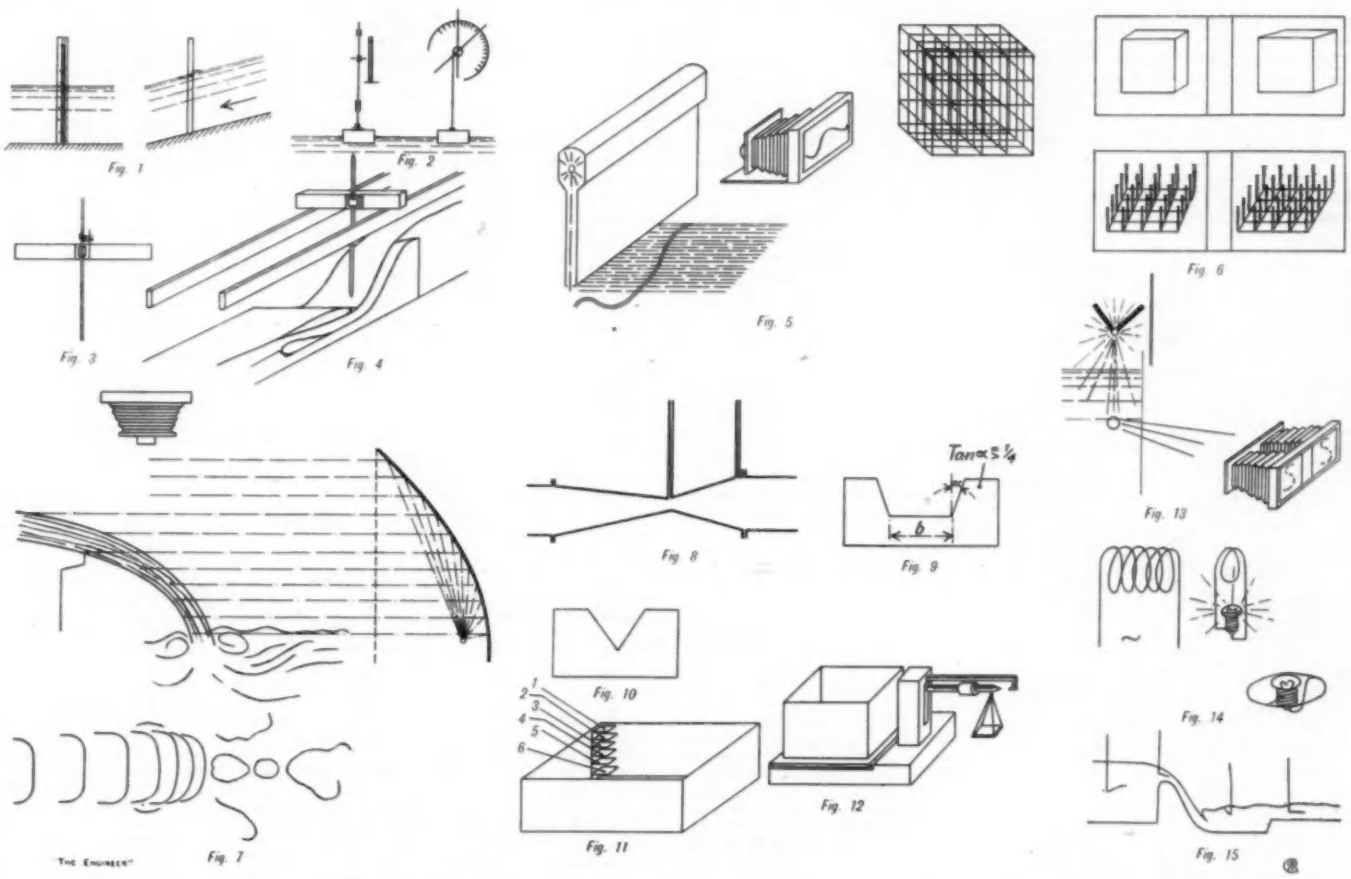
With the Venturi meter—Fig. 8—consisting of two cone-shaped pipes placed with their narrow ends together, and connected to the pipe line, there is no necessity to compare the pressures, since the difference in pressure at the wide section and at the narrow section is measured. There is, of course, room for a number of improvements in these methods, but water meters of this type are very convenient to use, occupy but little room, and may readily be connected up to the experimental apparatus. They give the momentary discharge ; that is to say, the discharge in unit time at the moment of observation.

The second method, which takes into account the position of the water level in any part of the stream, is very convenient, provided only that the connection between the water level and the discharge is known. The simpler this connection, the more convenient the method, so that choice falls on a notch for which this connection is very simple. For example, for the Cippoletti notch — Fig. 9 — $Q = 1{\cdot}86\, b\, h^{\frac{3}{2}}$. This method also gives the momentary discharge, and, like the first method, is very suitable for laboratory work.

In the gravimetric and volumetric methods, the water is allowed to flow into a tank of sufficient capacity—Fig. 11—and the increase in the volume or in the weight of the water during a definite interval of time is noted. In carrying out a gravimetric determination, the tank is placed on the platform of a suitable weighing machine—Fig. 12. The advantage of these methods is their simplicity, and the disadvantage lies in the somewhat unwieldy appliances required. The gravimetric and volumetric methods give the mean discharge over the interval of time during which the measurements are made.

The Velocity of a stream is not as a rule the same at every point, not even in the same cross section. Experiment has shown that laminary flow passes into turbulent flow within the range of a few centimetres per second. Under ordinary conditions, the theoretical mean velocity is merely relative, for a stream flowing at any marked rate consists of a large number of infinitely fine currents whose velocities differ both in magnitude and direction. Sometimes, when particular accuracy is not required, a simplification is introduced consisting in the assumption that the velocity is the same over the entire cross section. The velocity calculated in this way is called the mean velocity.

A number of instruments are in use for measuring the velocity of individual currents, and that most frequently met with in laboratory work is the Pitot tube. The principle of the Pitot tube is based on the well-known phenomenon that, on placing an object in a stream, a rise in pressure takes place in front of the body, and a fall in pressure behind it, the magnitude of the rise and fall in pressure increasing with the velocity. The Pitot tube—Fig. 16—is constructed on the manometer principle, and gives a difference in pressure from which, knowing the constant of the instrument, the velocity of the stream may be readily calculated. The value of the Pitot tube lies in its simplicity, both as regards construction and use. Its chief drawback is that, owing to its rather large dimensions, it displaces the stream, thus affecting the structure—Fig. 17. The Pitot tube gives the mean velocity of all the currents acting upon it. Owing to the inertia of the liquid in the manometer, the instru-



* See, for example, "Die Wasserbaulaboratorien Europas," p. 232, *V.D.I. Verlag*, Berlin, 1926.

† "Die Wasserbaulab oratorien Europas," pp. 336, *et seq.*

ment does not respond to rapid variations in velocity, nor altogether to the pulsations of the stream. Pitot tubes should only be used when the cross section of the stream is large. For small streams, such as in small models, the readings are unreliable.

The use of floats, Fig. 18, is another method for obtaining the mean velocity of a current. By measuring the time taken by the float to cover a certain distance, the mean velocity of the currents acting on the float may be determined. Floats lighter than water give the surface velocity, floats suspended in the water give the sub-surface velocity, while floats heavier than water give the bottom velocity. When the velocity is small, the method is satisfactory; but it is unreliable when the velocity is great, partly owing to errors of observation, and partly to the inertia of the float preventing it from following the current.

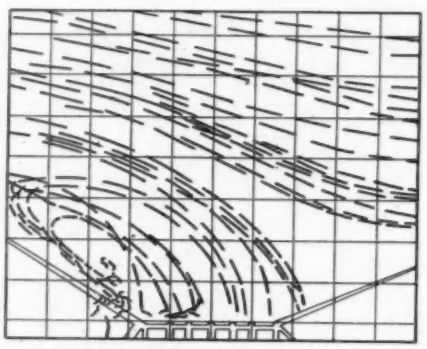
The method also gives the direction of the currents. In certain instances the use of photography makes it indispensable for many investigations. In this connection, reference may be made to experiments on models of regulators on the Yanga main irrigation canal and on the Dalverzin Canal, performed in the hydro-technical laboratory of this Institute. The following method for determining the direction of the surface currents in the main stream and branch streams was employed in the experiments on the Yanga main canal at the suggestion of D. Y. Sokolov. Floats were placed upstream on the surface of the water and their motion was recorded photographically. The shutter of the apparatus was allowed to remain open for some time and the floats left a trace of their motion on the photographic plate in the form of a series of lines.

In order to determine the surface velocities, D. Y. Sokolov employed a special shutter, which opened periodically for the space of one second each time. Small, lighted candles were placed on the floats, and the exposure was made in the dark. The traces of the images of the candles on the negative—Fig. 19—

Fig. 16

Fig. 17

Fig. 18



"THE ENGINEER" Fig. 19 ®

gave the velocity of the currents and the direction of their motion, as obtained by direct measurement on the photograph The above method for determining the magnitude and the direction of the velocity of different currents was found to be very satisfactory when working with shallow models, and to some extent in investigating motion on the surface of water.

This method offers many difficulties when it is applied to experiments with deep models, and to a study of the movements of sub-surface currents. For the purpose of direct observation, a weighted float may be used, of the same specific gravity as the water, it being assumed that the float follows the water in the current. In recording photographically the movement of this float with the view of determining the velocities of different currents, it must be borne in mind that the float does not move in a plane, but in space, and consequently the photograph will show only the projection of its path. This spatial path of the float renders it necessary to resort to stereo-photography with its subsequent evaluation as outlined above.

Another difficulty is that the float must be illuminated, since a dark, moving float will not be visible on the photograph. The writer came across this problem in carrying out some experimental work, and found the two following solutions:—The first consists in using a silvered float, illuminated by a source of light screened from the camera, so that only the rays reflected from the float can enter the camera —Fig. 13. A silvered glass bulb, such as those used for decorating Christmas trees, is employed as a float. The second solution is to use induced electric current, and to make a self-lighting float. The method of carrying this out in practice may be imagined as follows:—The model—Fig. 14—has an insulated wire wound round it in the form of a coil. A high-frequency current is passed along the coil, so that the model is situated within a magnetic field. If, now, within the model is placed a float consisting of a small electric bulb, connected in circuit with a small coil, a current will be induced in the coil, and will cause the lamp to light wherever it may be in the model. Naturally, the intensity of the magnetic field is not uniform everywhere inside the coil, but no great difficulty is expected in overcoming this. In order to test the author's suggestion, an experiment was carried out with satisfactory results.‡ A coil of copper wire was wound round the outside of a glass vessel about a foot in diameter. The ends of the coil were connected to the inductance coil of a 300-kilowatt short-wave transmitter. The float consisted of a small electric bulb, to which were soldered two loops of 0·22 mm. wire, the diameter of the loops being 40 mm. Owing to the short time available, it was not possible to counterpise the bulb with respect to the water, and so for the purpose of this preliminary experiment, the bulb was suspended by a thread. The bulb lit in a satisfactory manner. Notwithstanding its somewhat complicated character, this method offers very good prospects, since it will enable the motion of different currents to be followed photographically. In particular it ought to be very useful in the study of eddy currents.

A simple, but very good method for determining the direction of small currents is to use a silk thread fastened to a thin rod—Fig. 15. The silk thread follows the motion of the currents, and by using such a "probe" the flow of water in a model can be conveniently observed. The drawback to this method is that the rod interferes to a certain extent with the motion of the water, causing local disturbances in the flow of the stream.

The direction of flow of currents, their structural alterations, and the general character of eddy currents may be studied by introducing a dye into the investigated current. This method has been utilised by the author in some preliminary experiments on the impact of a jet. The disadvantage of the method, owing to the entire liquid becoming coloured, was avoided by chemical means. At the suggestion of V. T. Bulkin, potassium permanganate was used to colour the water, the colour being removed by means of oxalic acid in the presence of sulphuric acid. It should be pointed out that the colour of potassium permanganate is very suitable for both direct observation and photography.

To conclude, it does not appear out of place to emphasise the relatively short period during which experimental methods have been applied to the solution of practical problems in hydraulics. To this is evidently due the comparative paucity of laboratory methods of research. For, experience being gained only by practice, it is to be expected that new work and new research will bring new methods into existence.

‡ The experiment was carried out in accordance with the author's instructions by Messrs. Kazakov and Zotov, of the radio department.

Functions of Steel Plant Metallurgy.*

By R. E. SHERLOCK, Metallurgical Engineer, Donner Steel Company, Buffalo, N.Y.

WHILE the quality of the present-day automotive steels greatly surpasses that of yesterday, the steel manufacturers are keenly alive to the fact that present-day standards must advance to meet higher standards of to-morrow. Their desires to improve their products, to advance in quality production, are no less ardent than are those of the immediate consumers in perfecting the manufacture and performance of finished parts. These advancements must proceed hand in hand, each leaning and depending upon the other, and actually progressing through the observation of causes and effects, and *vice versâ*. It is the primary duty of the metallurgists to delve into and to study the inherent qualities of the metal products used in their individual industries, and thereby determine the merits of these materials, not only in shop production, but in every-day use as well, and to strive constantly for improvement. In the steel plant whose products are largely for the automotive industry, the principal functions of the metallurgical division are to supervise the melting, casting, rolling, and processing of the steel throughout the plant. This necessitates very close co-operation with all departments, to ascertain the quality of the product and to improve that product without being unmindful of the cost of production; to conduct experimental and research work in the melting and handling of steel, as well as on the properties of the finished materials; to become familiar with customers' operations, their methods of inspection and testing, so as to supply them with a material which, in all details, is most desirable for their individual needs; and, finally, to test out the finished material and pass judgment on its application.

To manufacture quality steels, a mill must adopt some definite standards on quality. A most necessary duty of the metallurgical department is to set up such standards. Once set up, comparisons are made regularly and knowledge is gained as to whether or not actual improvement is being made. Cleanliness and soundness—aside from chemical analysis—are the fundamental principles of steel quality, and such features as controlled grain size, freedom from fibre, &c., are classified more in the nature of refinements. A good practical method of recording the fundamentals of quality steel is by the merit number system which may or may not refer to micrographs or macrographs. This system of recording the cleanliness or soundness of a heat of steel by giving it a number rating is much superior to simply classifying it as "fair" or "good," &c., as it gives a numerical basis to work to or to make comparisons with, as well as the advantage of plotting graphs. From such data certain classes of steel are studied with the idea of identifying the type of impurity or defect predominating and of locating faulty practice in the manufacture. These situations are fully discussed with the furnace department representatives and corrective methods are put into effect or experimental heats made at once. This same system is carried out with controlled grain size, banding, fibre, and other features. Only a short time ago, in speaking of grain size, normality, or other phases, a melter would be more or less disconcerted, not knowing what was being referred to. This is not true to-day, as heats are made to specifications including a wealth of detail other than chemical analysis, and great interest and concern is shown by the men on the floor in the making of heats, the specifications of which call for the more exacting refinements. The metallurgical division must drive home the quality standards to the open-hearth and electric furnace men, and, while this is not always an easy task, once accomplished, the interest and co-operation shown is surprisingly great. Furnace practice is laid out on a definite plan with a definite object in view, and the metallurgical department must see that these instructions are carried out and carried out properly. To-day, the furnace operators themselves are surprisingly familiar with the various phases of quality now in demand. Among other things, which are at regular intervals very closely watched, are the iron and scrap as well as other raw materials, the slag, its composition and condition in the furnace, deoxidisers, the casting temperatures, the moulds, nozzles, mould washes, &c.

The rates of heating and cooling of steel and the rolling temperatures are checked regularly, even after standard practices are adopted. We are all aware that the best rolling temperature from a production standpoint in the mill is not always the best rolling temperature from a metallurgical standpoint. Many customers wish to machine hot rolled steel at a high speed, to fabricate it cold by punching or bending, without being burdened with the expense of annealing, and their ability to do so often depends upon the micro-structure as well as the hardness. In other cases, to obtain a certain response in annealing or heat treating, it is desirable to start out with a fairly definite grain structure in the hot rolled steel. It therefore often follows that the rolling temperatures must be controlled to obtain a micro-structure basically correct for subsequent operations.

It is likewise true that the cooling of steel after rolling is quite important. In some cases, rapid cooling is desirable, particularly for machining purposes. Usually, however, slow cooling is of much greater importance. In fact, it is necessary in certain sensitive alloy steels to prevent internal strains and ruptures, and in others to obtain sufficient softness for cold shearing or cold working. To effect this, provision is made by packing the hot bars on the beds, the use of specially constructed cooling beds, cooling chambers, cooling pits, covering the hot steel with sheet iron, cinders, &c. At times, however, there is a non-uniformity of hardness, and this is often due to cold weather or to a cold cooling bed at the beginning of a rolling.

Possibly it would be advisable to add a few words in regard to the cold shearing properties of steel, as they are assuming an ever-increasing importance. On account of their chemical composition, many of the alloy steels rolled to-day, such as the higher carbon grades of the S.A.E. 6100, 5100, 4100, and 3200 series, are slightly self-hardening. This natural hardness is dependent, further, on the size, the finishing rolling temperature, and the rate of cooling. A concrete example is chrome-molybdenum steel over ·40 carbon. Cold shearing is, as a rule, safely accomplished on rounds under 1in. and on squares under 1¼in. On sizes slightly larger, the cold shearing properties are doubtful, while on still larger sizes cold shearing is practically impossible. While affected by the grain size and the existence of strains, the ability to cold shear such steels depends on their hardness. While such steels can be annealed so as to cold shear satisfactorily, difficulty is met in obtaining the necessary extra to cover the annealing costs. Consequently, the mills are doing everything possible to effect slow cooling after rolling in order to avoid the necessity of this annealing, but this impedes production and increases costs for handling. Of course, there are many grades that cannot be cooled sufficiently slowly after rolling, and must be annealed to shear satisfactorily. The ability to cold shear satisfactorily is often in the customer's hands, in that a shear of sufficient capacity be used, that the shear blades be of the proper design, in good condition and in good alignment, that the bars or billets be well supported, and that, in case of square sections, they be sheared diagonally. By no means does it follow that, because a heat shears satisfactorily in one plant, it will do so in another, as the equipment may be quite different. Another factor which lies entirely in the customer's hands is the temperature of the steel during cold shearing. It should not be necessary to state that it is very poor practice to cold shear billets, which have been exposed to the winter weather for a few weeks, without first taking the chill out of them; yet this is done a great deal and cracking results. While a plant may not have facilities for warming such billets to room temperature, it is hardly fair that the mills should be held in criticism for all such difficulties. We might mention, further, that some plants have put in steam coils on their shearing tables to remedy this condition. These points have been brought out to show that it is a difficult matter for mills to guarantee cold shearing properties on certain grades of hot rolled steel.

Under the supervision of the plant metallurgists, there are constantly being put through innumerable experimental investigations. Practically 95 per cent. of these are with two definite objects in view, namely: (1) improvement in the inherent quality of the furnace product; and (2) improvement in the surface condition so as to reduce chipping costs. The first involves principally the inspection of various kinds of raw materials, the physical chemistry of slags, melting conditions, temperatures, and the use of various kinds and amounts of deoxidisers. Such work as this has always been carried out in steel plants, and we might add that very frequently a single

* Paper read before the American Iron and Steel Institute New York, May 24th, 1929.

experiment has been needlessly carried out in a plant several times for the reason that the original experiment was not carried out to completion, or that its results were not accurately recorded. To-day such work is carried out on a scientific basis; written records are carefully kept and are the permanent possession of the company.

The second involves the exploration of that vast field which has a bearing on surface, such as runner spouts, nozzles, stopper rods, pouring temperatures, pouring methods, moulds, mould washes, hot tops, ingot heating and soaking, amount of draught in the blooming mills, method of rolling, cooling, and many other details. To an outsider, chipping costs probably do not mean very much, but they are the heart throbs of the steel operative. The conditioning of billets preparatory to first rolling is without question one of the most important stages in the production of steel. Without going into details, we would say that surface defects originate from a multitude of causes, many of which are often difficult to trace, and such a condition usually calls for the utmost perseverance and study to attain improvement.

Commercial and Select Forging Steels.

We believe that, at this point, it would be appropriate to comment on the two classes of carbon steel commonly produced to-day, namely, commercial steels and select forging steels. There seems to be considerable misunderstanding in the trade in respect to these steels, and while this misunderstanding may be largely due to the steel mills themselves, we believe it well that certain lines of definition should be laid out for the differentiation of these two classes. Commercial steel is the product of an ingot which has been cropped only to the extent of removing the visible pipe and rolled from unchipped billets—or chipped only to the extent of removing bad tears and similar defects. Select forging steel, on the other hand, is the product of an ingot which has been more amply cropped and rolled from chipped billets which, in most cases, have been previously pickled. That different parts of an ingot vary in composition and that the top part varies more than the middle or bottom parts are recognised facts. It therefore follows that the commercial steel, having the lesser discard, will on the average vary more in chemical composition than will select forging steel. Any undue chemical variation in commercial steel is not characteristic of the whole ingot, but largely confined to that part directly below the top discard. The consumer may not detect such a variation in his own check analyses, for the reason that, in the first place, it may not exist in all steels, but for certain parts it is considered reason that, if present, it exists in such a relatively small percentage of the material that his samples are apt to be selected from another and more uniform portion. Commercial steel varies more in composition than does select forging steel, and its application on parts calling for rigid chemical limits or uniform physical results after heat treatment is attendant with risk.

It is likewise a fact that the surface of the bars is directly dependent upon the surface of the billets. As commercial steel bars are rolled from unchipped or lightly chipped billets, they are subject to some surface defects. Should the billets be good, the resultant bars will be good; and should the billets be only mediocre, the bars will be pretty much the same. On the other hand, the select forging bars are rolled from chipped billets which, in many cases, have been previously pickled, and such bars on the average have a much superior surface. The point which we wish to bring out here is that this grade of steel cannot be guaranteed by the manufacturer for forging purposes, as the surface is an uncertain factor, although kept within reasonable limits. There are many cases where it can be used for forgings, particularly those of simple design or relatively unimportant parts, but whether or not such a steel is to be used for forgings at all is a question for the user to decide and at his own risk. It is not at all unusual to find a consumer who has used commercial steel—at a saving in price over select forging steel—for forging purposes, and, after having had good success with possibly three or four heats, encounters fairly large rejections on a fifth heat, on which he promptly enters a bitter complaint to the effect that the steel has not been up to past standards. This is an entirely erroneous attitude. The merit of commercial steel must be based on average heats. On the other hand, commercial steel may be used to very fine advantage in many cases, namely, for structural purposes, bolts, rivets, nuts, forgings of simple design, &c. With select forging steel it is obvious that, on account of the loss sustained by the extra discard and for the cost of pickling and chipping the billets, the selling price is higher than that of the commercial steel. Chemically and physically it is a better steel, and it is our firm belief that, covering any reasonable period, it is a cheaper and far more satisfactory product for the forging trade.

Physical Testing and Heating Treatment.

The determination of physical properties is routine laboratory work, and while it is carried on primarily for approving specific heats or rollings for application on orders specifying definite properties, it is also carried on for the compilation of data to be used at standards and for the bases of future recommendations. In this work, which is carried out on hot rolled, annealed, heat-treated or cold-drawn steels, as the case may be, we find that the tensile and Brinell hardness tests are of first importance. While few specifications call for transverse tensile testing, there is a certain amount being done, as it has been found that the ductility determinations are a very good indication of the quality of the steel. In respect to hardness testing, the Brinell machine is used very extensively; the use of the scleroscope is somewhat limited, and the Rockwell machine is coming into more and more prominence. The remaining mechanical tests that are most commonly used are the torsion, impact and cold bend tests. In the mill laboratory, fatigue and possibly magnetic testing will undoubtedly come into greater prominence, particularly for research data.

The testing of steel for fibre is quite extensive. There are two general types of fibre, that associated with low-carbon steel, often referred to as woody, shelvy or laminated, which is observed after carburising, heat treating and fracturing the test piece longitudinally, and that observed in higher carbon grades, referred to as reedy or woody, after normalising or quenching, drawing to a sorbitic condition, and fracturing transversely. Fibre exists in all steels, but for certain parts it is considered detrimental and it is highly desirable to keep it at a minimum. The chief merit in ordinary transverse fracture tests is the detection of pipe or interior flaws or flakes, and the observance of grain refinement. An examination of a longitudinal fracture is often a very good check for non-metallic impurities. Considerable experimental heat treating is carried out with the various types of steels, and the resultant data is of great assistance in working out annealing and heat-treating practice to be followed commercially. There is a very close co-operation between the laboratory and the plant annealing and heat-treating departments.

Microscopic Work.

If used by an intelligent studious observer, the microscope is an invaluable instrument in the laboratory; if carelessly used, very misleading and erroneous conclusions are frequently arrived at. After a representative number of samples are selected from representative areas of the material to be examined, reasonable care must be taken to avoid throwing in polishing defects which might be mistaken for non-metallic impurities. To examine for cleanliness, 100 magnifications is generally used. For comparative purposes, a merit number basis is undoubtedly the best way to record a heat or lot in this respect. From the mill point of view, the status of any heat or lot in respect to cleanliness should be based on the average size, average amount and uniformity of distribution of the non-metallics, as observed in a reasonable number of micro-sections. Some laboratories base acceptance or rejection on the worst area of the worst section examined. We feel that this is wrong, in that a heat of steel may be an entire loss to the manufacturer for the reason that ruthless rejection has been based on this principle, and we would also say that few heats, irrespective of their source, would pass on this basis if the observer should take a sufficient number of additional tests. An occasional inconsistency is met with in that a customer specifies a liberal sulphur maximum, and yet complains on the excessive amount of manganese sulphide as noted under the miscrocope. In plant work it is quite important that the general identity of the impurities be known, so that corrective measures can be made in the furnace department. Exact identity is at times a most difficult matter.

In routine work, there is less total work done on micro-structure than there is on impurities. Micro-structure is most necessary, however, in checking shipments for machining purposes, as grain size has an important bearing on this. As a specific structure for good machining at one plant may be essentially different from that at another, it is well to have on hand individual samples and micrographs in order that comparisons be made, and, from such standards, rolling temperatures and annealing treatments can be prescribed. As a usual thing, to get good machining properties in unannealed material, it is advisable to roll a steel hot, which gives a large and more brittle grain, whereas, if the material is rolled cold, a small tough grain is obtained and this usually causes tough machining. The micro-structure is also very important with certain grades, particularly the high carbon chrome steels, which must be annealed, cold worked and heat treated; in such cases, the small grain produced by rolling cold is most desirable. As stated previously, for the successful cold working of many steels, such as cold bending, twisting, spinning, stamping, unsetting, &c., the correct micro-structure is of equal importance to low Brinell hardness. In some steels, particularly the nickel and nickel-chrome grades, which have been subjected to slow cooling, the ferrite and pearlite are inclined to segregate in layers, and this is known as banding. This condition has not been criticised greatly, although some users feel that a steel having this characteristic does not respond to heat treatment quite as well, and is more inclined to warpage. In development work and in the examination of material which has not been forged or heat treated satisfactorily at a customer's plant, the structural investigation is very important, as it reveals fairly definitely just what care has been given it in these operations.

At the present time, an immense amount of work is being done throughout the country on grain size, as observed after the McQuaid-Ehn test. On low carbon steels, many plants now have size charts which are used as standards and have specified a certain range for this material. The control of grain size has been an exceedingly difficult problem for the mills, and research work on this phase is going on at a high rate in this respect. In an effort to produce tougher steels, this work is also being carried out by the mills on the higher carbon grades.

Contact with the Trade.

Mass production in the automobile industry has demanded that there be no hold up on account of faulty or improperly conditioned steel. To guard against this, and to put into service better and more rugged parts and units, their respective metallurgical and inspection departments have had much greater responsibilities thrown upon them. These departments have increased in size, have given their raw material a much more thorough inspection in regard to details, and have devoted a great length of time in studying particular phases in respect to production and uniformity of quality. In studying effects in the manufacture and testing of the more important parts, collective data often indicate that good or poor results are dependent upon or associated with certain characteristics in the steel. The conclusions arrived at in one plant often coincide with those arrived at in another plant manufacturing similar parts from similar steel and under reasonably similar conditions, and, again, they may be quite opposite. Irrespective of this, the stage has arrived when certain customers demand particular characteristics in the steel, and failure to comply with these demands means rejection, although the terms of the written specifications, or order, have been fully complied with. Printed specifications are most valuable for a steel mill to work to, but many minor points are not therein covered, and, as a matter of fact, it would be difficult to include them, as they are more or less tentative. There may be a desire to lean to the top or bottom of the chemical range or to have a balance of the elements, their standards of cleanliness or grain size may not check at all with your own, their method of locating samples, preparation, treating, or testing may be entirely individual. When these details are not rightly understood, the two laboratories may well arrive at different ratings, each correct according to its own standards, but the steel mill would be held guilty.

Many customers have drawn up their individual specifications in printed form with a number listing and we feel that this is a most correct procedure. In drawing up a specification, however, a customer should have the sources in mind as well as his own plant, to avoid any undue hardship being thrown on them. For example, a customer may specify an unusual grade of steel having very narrow carbon limits, very high limits of cleanliness, or some other strict details. Should a mill make a heat which falls slightly outside of the chemical range, or fails to fall within the cleanliness limits—and this sometimes happens under the best of conditions—the heat would necessarily be scrapped, as there would be no outlet for it, and the entire loss thrown on the mill. The customer, undoubtedly, needs such a specification for a particular highly stressed part, but provision should be made to the effect that, should a mill fail to make a heat up to all qualifications, it would be permissible to apply it on a different size or for a different part, which is of less importance. These remarks are in direct reference to unusual or little used analyses, and not in reference to those commonly used.

The business of the field representatives of the metallurgical department, assisted by various operating representatives, is to keep in close personal contact with the metallurgical, operating, inspection and development departments of their customers and prospective customers. In a large number of plants it is imperative that before orders may be solicited a steel source must be placed on an approved list in so far as quality is concerned. The mill must give a reasonable demonstration and guarantee that their product will pass the requirements. This can only be accomplished by preliminary work between the two metallurgical departments, and consequently it is a vast help to the selling organisation to get under way. However, once established, there can be no let-up on contact work, and, as a matter of fact, it must continue most persistently in order to learn the multitude of details surrounding inspection and production phases. This information comes directly to the mill, and by full use of it every effort is put forth to produce exactly what is wanted. Probably the majority of complaints and rejections of steel are due to a lack of knowledge on the part of the mill as to the specific use, method of inspection and manner of production of the material. In case of error the mills often unjustly bear the hardship. These situations are being largely reduced by personal contact, and in this important co-operative work the mills have kept in the van. It is not the purpose of the mill representative to pry into secret practices and air them around the trade; his duty is to carry to the mill only such information as will better enable it to supply the customer with the product best adapted to his particular purpose. To-day there is a great fraternal feeling among metallurgical representatives of various industries, and through the exchange of opinions much good has been accomplished. One outstanding feature of contact work is the confidence gained by the user for his sources. For example, there are numerous alloy steels made to rather narrow chemical limits, and even under the most careful melting the mill will make an occasional off-grade heat. Obviously the heat is rejected by the mill if one or more elements fall very far outside the specified range, but should the chemistry fall outside the limits only slightly, it frequently receives the approval of the customer by telling him beforehand the exact analysis and various checks and asking his permission to apply it. If not carried to excess, this co-operative procedure is of direct benefit to both parties, the mill is not handicapped by scrapping the heat, stocking it for an indefinite period, or missing a rolling schedule, and the customer is also able to meet his own production schedules.

The activities of the field representatives carry into all kinds of manufacturing plants and consequently their experience is broad and their opinions sound and well worthy of attention. Their advice and recommendations are given gratis and they have saved customers many thousands of dollars. In the work of co-operation with their customers, through personal contact, the steel plants do not suffer in comparison with other industries. The results accomplished are well worth the effort, and it is hoped that the future will bring about a closer contact of the customers' representatives with their sources, so that they may better understand steel plant problems and conditions as the steel representatives have endeavoured to understand theirs.

B.E.S.A. SPECIFICATIONS.

THE DETERMINATION OF VISCOSITY IN ABSOLUTE UNITS.

A revised issue of B.S. specification No. 188, 1929, British Standard Method for the Determination of Viscosity in Absolute Units, has just been published by the British Engineering Standards Association. The first edition of this specification appeared in 1923, and the present revision was undertaken in the light of criticism and suggestions which have since been received. The opportunity was taken of recasting the entire specification, and also of introducing data likely to be of service to users. The revised specification should prove of considerably increased value to all laboratories engaged in work on viscosity. Copies of the specification can be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

A further improvement in the equipment at the Capetown Docks will shortly be made by the replacement by four grab cranes of the overhead transporters which have been in use for many years just inside the docks area for stacking and handling from and into trucks of bunker coal kept on hand ready for delivery at short notice to the ships' sides.

North-East Coast Exhibition.

No. V.*

WE continue below our description of the apparatus and machinery now on view in the Palace of Engineering at the North-East Coast Exhibition, Newcastle-on-Tyne.

BEVER, DORLING AND CO., LTD.

The principal exhibit on the stand of Bever, Dorling and Co., Ltd., of Bowling Ironworks, Bradford, is the Malcolm-Feuerheerd roller pump, of which various designs and sizes are shown. It will be recalled that this novel type of roller pump was described and illustrated in THE ENGINEER of November 25th, 1927. The pump which we then described had an output of 120 gallons of lubricating oil per hour when running at 1000 revolutions per minute, but the design has now been so developed that pumps having capacities up to 50 tons of petrol per hour with branches up to 10in. in diameter are supplied. Pumps have been specially designed for dealing with light fluids, such as petrol and spirits, and with heavy products, such as molasses and tar. It will be remembered that the essential principle of the Malcolm-Feuerheerd pump consists of a shaft set excentrically to a roller race, in which a number of trailing rollers work. By reason of the excentricity, the space between any pair of adjacent rollers opens out as the rollers pass over the suction port, and, after opening to the maximum amount, retain their relative positions until the delivery port is reached, when the space between the rollers is reduced and the liquid between them forced out. This action takes place in all the spaces between the rollers, and various numbers of rollers ranging from two to five are employed. When pumping oil or other good lubricants the pump bearings, as shown in Fig. 42, are embedded in the pump casings, but for non-lubricating liquids, such as water, petrol, paraffin, outside bearings, usually of the roller type, are fitted. Illustration Fig. 42 shows a section through a five-roller pump in which the excentricity of the roller path may be varied, thereby altering the capacity of the pump. To do this the roller path is made a separate casting, which is spring-supported and is housed within the main body of the pump. By raising or lowering the block forming the roller path the output is reduced or increased. An indicator which enables the attendant to set the pump to meet any required pumping capacity is provided on the top of the pump. This feature has been found to be particularly useful for boiler feed pumps required to deliver variable quantities of feed, and it has also been usefully employed on pumps used for blending different liquids, as it enables varied proportions to be delivered simultaneously into a common receiving vessel.

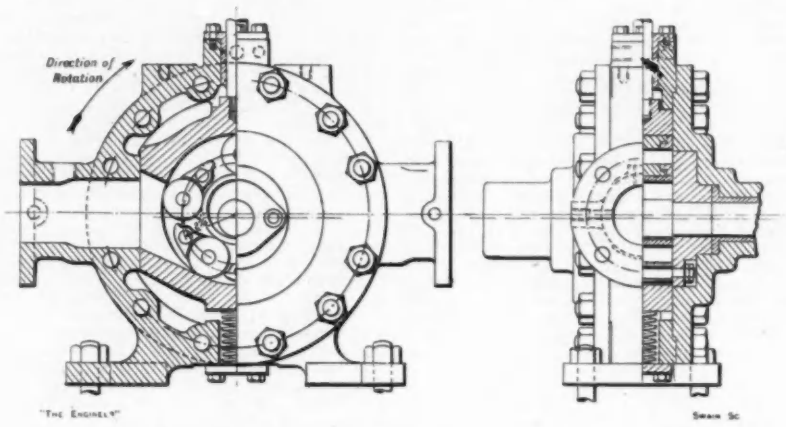


FIG. 42—MALCOLM-FEUERHEERD VARIABLE CAPACITY PUMP—BEVER, DORLING

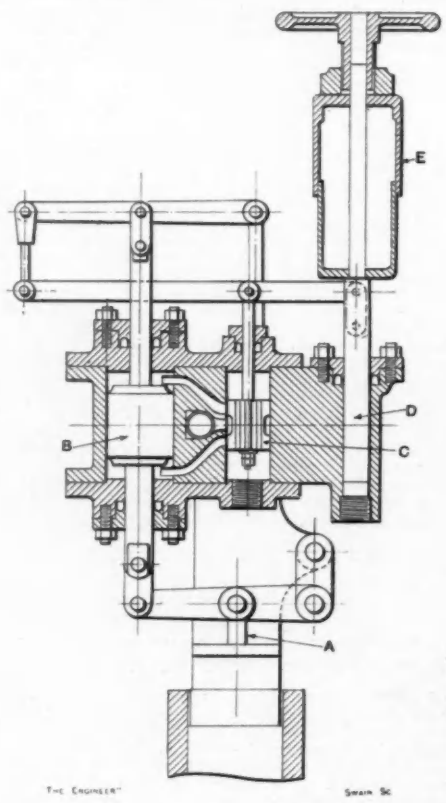


FIG. 43—HYDRAULIC CONTROL GEAR—BEVER, DORLING

It will be readily understood that such a variable delivery pump readily lends itself to a system of hydraulic control, and in Fig. 43 we show a section through the automatic hydraulic control gear, which is exhibited in operation on the motor-driven set illustrated in Fig. 44. A spindle A is connected to the roller race block, and the lifting or lowering of it varies the excentricity, which is increased when lifting and decreased when lowering. The plunger D is in communication with the delivery pipe of the pump, so that the pressure in the delivery pipe acts on the plunger. This pressure is counterbalanced by a nest of springs enclosed in the spring box E, the pressure exerted by which can be regulated by means of the hand wheel shown.

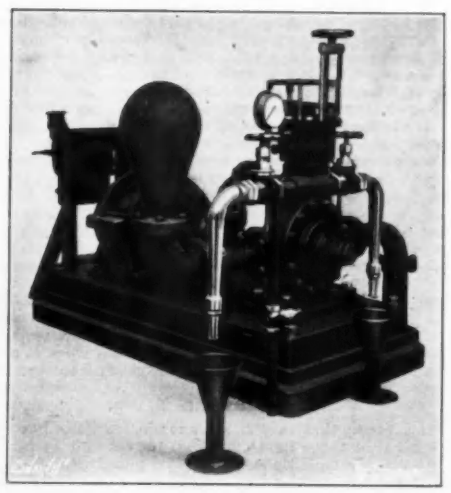


FIG. 44—PUMP WITH CONTROL GEAR—BEVER, DORLING

When the pressure on the delivery pipe is increased, the plunger D is raised and it, in turn, lifts the small piston valve C. The central portion of the valve is so connected with the delivery pressure that when the valve is raised it causes the delivery pressure to be transmitted through the upper port to the top side of the piston B, thereby depressing it. By means of the system of levers below the piston the spindle A is forced down, thereby lowering the roller race and reducing the capacity of the pump and the pressure in the delivery pipe. At the same time, because of the movement of the upper arrangement of levers, the small piston valve C is brought back to its mid position, thus stopping the movement. It will be seen that the control arrangement is virtually a hunting valve gear, which has the effect of always bringing back the valve to the central position after the piston has moved an amount proportionate to the increase of pressure. The particular pressure at which the automatic control comes into action can be determined by turning the hand wheel and compressing the springs within the box E, more or less, as requirements may demand.

Another exhibit of interest to mining engineers is the Bever's patented overwinding control gear, illustrated in Fig. 45. It provides for a separate control of the steam throttle valve and the brake, which can be made variable. The gear, as shown in the drawing, consists essentially of a governor driven by bevel wheels from the drum shaft either by means of a drag link or a chain gear. The governor is specially designed to give a large range of control, and it has a lift of between 3¼in. and 3½in. It will be seen that the driving shaft is prolonged and has mounted upon it a worm which meshes with a work wheel on a shaft at right angles to the driving shaft upon which two cams are mounted, one for the steam throttle valve control and the other for the brake. The cam shaft makes almost one complete revolution for each wind. There are vertical spring-controlled rods for each cam, which operate the trip gear for the steam and brake controls.

Assuming that the winding engine has been correctly started, the sequence of operations is as follows:—The cam controlling the steam admission begins to revolve in a counter-clockwise direction and the cam rod following the profile descends and the tappet rod rises, moving the stop away from the trigger. Should, however, the speed of the engine increase beyond the normal, the governor rises and through the system of levers lifts the tappet rod, thereby operating the trip gear and cutting off the supply of steam. The design of the gear is such that the engineman must run at a predetermined speed for which the cams have been cut. Should the engineman be incapacitated at any period during the wind, then the engine will continue to run at a speed not less than that at which he lost control. The rotation of the cam, however, will lower the tappet lever and trip the gear, cutting off steam at the point at which the speed of the engine should have been reduced. A pointer is attached to the rod, which clearly indicates when the speed of the engine is approaching a dangerous limit. Should the engine be started at any time in the wrong direction, the cam rotates in a clockwise direction and the sharp-nosed cam lifts the rod and releases the trigger of the trip gear. The cam profiles are so designed that adjustment can be made in the event of the rope stretching or other causes arising which might call for fine adjustments to be made. In some cases a pointer with a dial and gong are fitted on the cam shaft and form a winding indicator.

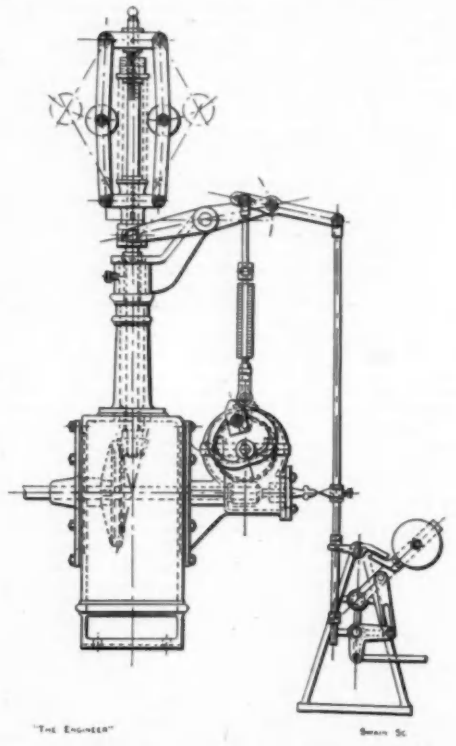


FIG. 45—WINDING ENGINE CONTROLLER—BEVER, DORLING

RILEY BROS. (BOILERMAKERS), LTD.

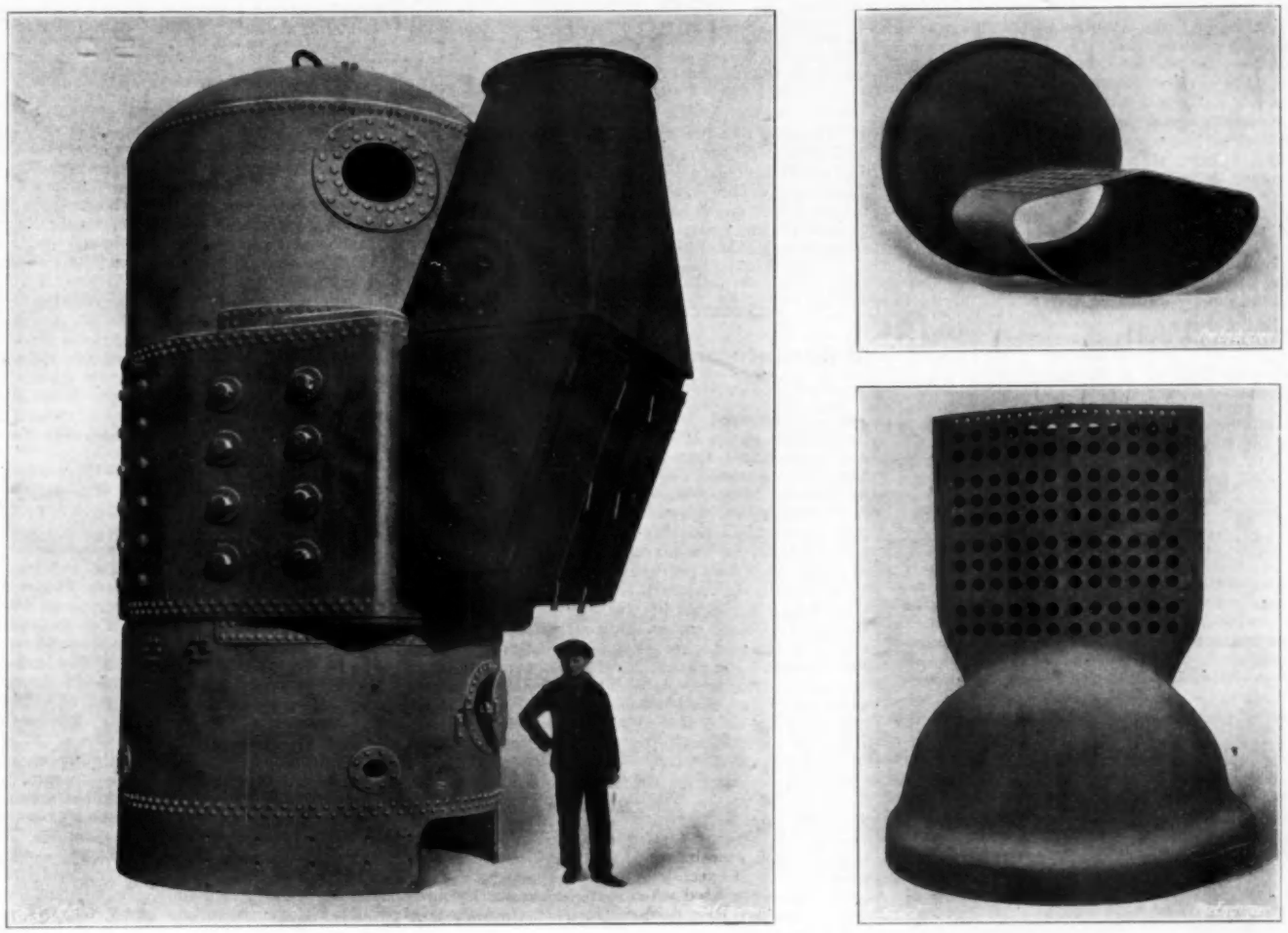
On the stand of Riley Bros. (Boilermakers), Ltd., of Stockton-on-Tees, there is a large Riley patented vertical multitubular boiler similar to that illustrated in Fig. 46. These boilers, which are of novel design, embody several interesting features. They are manufactured in sixteen standard sizes, beginning with the smallest, a 3ft. diameter boiler, 6ft. 9in. high, and ending with the largest 8ft. 6in. diameter boiler with an overall height of 17ft., generally similar to that shown in our illustration. The largest boiler has a heating surface of 1010ft., with a grate area of 44ft., the evaporation at easy steaming rate

* No. IV. appeared June 7th.

from and at 212 deg. Fah. being 6350 lb. The weight of the complete boiler is about 14 tons. The actual boiler shown on the stand is a 6ft. 6in. diameter unit with a height of 14ft. 6in., and facilities are provided to enable visitors to inspect the internal parts. Fire-boxes and combustion chambers for the largest and smallest sizes of boilers are also on view, showing the different constructions of fire-box and combustion chamber adopted. In addition to these exhibits there is an end-plate for a marine type boiler and a steam dome crown such as is fitted on the boilers of drifters and other craft.

In Figs. 47 and 48 we illustrate the firm's patented seamless fire welded fire-box and combustion chamber, which, together with shell, forms a three-plate boiler. The adoption of a bevelled tube plate is claimed to provide a wide passage immediately over the fire-box top, which assists in liberating steam and ensures a rapid circulation up the centre of the boiler and down the sides. There is, moreover, a good body of water over the top of the fire-box, and the arrangement is one which gives access for cleaning.

With the domed combustion chamber shown and with the segmentally-shaped uptake it is claimed that there is no throttling when the gases are leaving the furnace, while the design of the furnace and combustion chamber is such that there are no riveted seams in the direct path of flow of the gases, all the seams being fire-welded on the hearth. From the shape of the welded component shown it will be seen that there is a large area of plate surface exposed to the hot gases and in direct contact with the flame, which makes for good steaming properties. The patented method of furnace construction adopted by the firm enables the full thickness of the plate to be maintained at the crown of the furnace, which is an important advantage. When cleaning the internal parts it is possible, the makers explain, to reach all parts of the boiler, either through the wide space between the two diverging nests of tubes immediately over the furnace crown, or down the side spaces between the shell and the two tube banks, while a workman can also expand the tube ends within the combustion chamber without having to dismantle any part of the boiler. The boiler we describe has been built for coal, oil and waste heat firing, and for the latter purpose a central circular combustion chamber suitable for radial thimble tubes can be conveniently adopted.



FIGS. 46 TO 48—VERTICAL BOILER WITH WELDED FIRE-BOX AND TUBE PLATE—RILEY

VICKERS-ARMSTRONGS, LTD.

The large stand of Vickers-Armstrongs, Ltd., is noteworthy for the wide range of its exhibits, which are representative of the activities of the firm's Barrow and Elswick and Sheffield works, and those of allied companies. We have selected for special mention, first, a new development in cement kiln practice, and, secondly, a new type of brass alloy with which, it is claimed, very good results are obtained. In Fig. 49 we reproduce a photograph of a model kiln fitted with the new type of Vickers-Armstrong "Recuperator," as shown on the stand.

Until recent years, rotary kilns in the cement industry have generally operated in conjunction with inclined open-type rotary clinker coolers, situated either directly in line with the kiln or brought back underneath the firing floor. In either case, the kiln had to be erected at a considerable height above the ground level, which necessitated tall, massive foundations, high buildings, taller stacks, elevated gangways and firing floor, with ladders, &c. &c. As a means of countering these disabilities, Vickers-Armstrongs, Ltd., has designed a recuperator which enables the kiln to be erected practically on ground level with reduced foundations, lower buildings, and avoiding raised floors, which, the firm points out, effects considerable saving in both capital cost and erection.

The rotating inclined cylinder hitherto utilised for cooling the clinker has been termed a "cooler," because, at the time of its first appearance, its primary duty was to cool the material so as to deliver it at such a temperature that it could be mechanically handled without difficulty. At that time, although a proportion of the heat was returned to the kiln, no serious attention was given to the conservation of heat or to the actual amount of heat recovered for use in the kiln. It is for this reason that Messrs. Vickers-Armstrongs, while they still refer to the clinker "Coolers" when supplying rotary kilns with separate cooling devices, prefer the name of "Recuperator" when used in connection with kilns having cooling devices in prolongation.

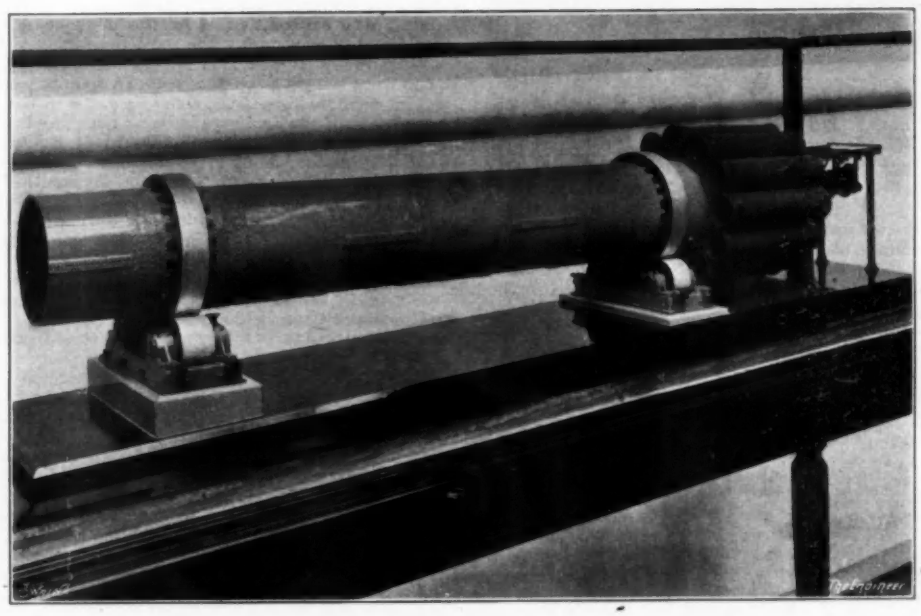


FIG. 49—CEMENT KILN "RECUPERATOR"—VICKERS-ARMSTRONGS

Referring to Fig. 50, the main body of the recuperator A is formed by the prolongation of the kiln

shell. This section tapers towards its discharge end, which retards the rate of travel of the material, and the high-grade heat recovered from the material is returned directly into the burning zone of the kiln. The material is discharged by the chutes B into twelve or more auxiliary outer cylinders C. By travelling about 20ft. down the main kiln, the clinker loses its high-grade heat and passes into the cylinders at a moderate temperature. It is then finally cooled and conveyed through these cylinders by special cascaders which deliver it to the point D. In order to remove the maximum amount of heat from the material in the main body of the recuperators, lifters E, which are of such a size as to turn the material over, and at the same time maintain a clear vision through the kiln into the burning zone, are employed. The main body of the kiln is lined with fire-bricks, and the chutes have renewable liners. The feed end of each outer

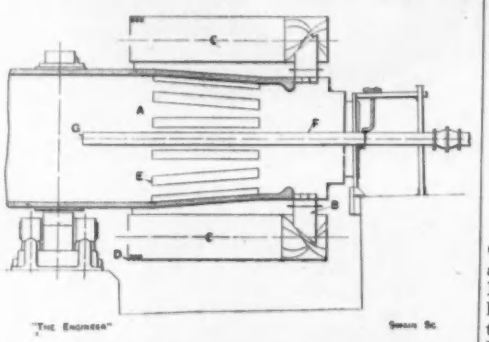


FIG. 50—SECTION THROUGH END OF KILN—VICKERS

cylinder under the chute is lined with renewable plates, which, together with the lifters and liners in the main body of the recuperator and the chutes, are of special heat resisting metal. The cold air, entering the outer cylinders C, at the end D, travels directly into the kiln, in the opposite direction to the flow of the material, taking with it the heat recovered.

The firing pipe shown at F is adjustable, and it extends, as indicated, through the main body of the recuperator. It is fitted with a firing end of specially treated steel, and may be rotated. The nozzle G is in the same position relative to the kiln-burning zone as in ordinary practice.

In Fig. 51 examples are shown of a new alloy metal, styled P.M.G. brass, which has been developed at the

FIG. 51—P.M.G. BRASS CASTINGS—VICKERS

Vickers-Armstrongs Barrow-in-Furness works, and examples of which are on view at Newcastle. The object aimed at in making this new alloy, was, we learn, to produce a superior quality of brass, which, while comparing in cost with Admiralty quality gun-metal, would, nevertheless, exhibit better physical qualities. For cast P.M.G. metal the firm gives the following comparative figures :—

	P.M.G. brass.	Gun-metal.
Specific gravity	8·39 ..	8·82
Yield point, tons per sq. in.	11 to 13·6 ..	7·9
Tensile strength, tons per sq. in.	18 to 22 ..	16 to 22
Percentage elongation on 2in.	8 to 18 ..	8 to 28
Brinell hardness number ..	100 to 115 ..	75 to 95
Izod impact test, foot-lb.	20 ..	14

For forged or extruded brass of the P.M.G. quality, yield points of from 20 to 22 tons per square inch with an ultimate tensile strength of 33·6 tons per square inch are, we understand, to be obtained. The elongation on a 2in. length is 38 to 42 per cent., and the value for the Izod impact test works out at 36 foot-pounds. The material also shows good qualities when tested under heat, and these are well borne out by the test figures in the following table.

The new alloy is stated by the makers to contain no low melting point metals, and foundry procedure is simple. The examples we inspected showed a close grain and we understand that the castings made in this new brass are able to withstand high water test pressures. To verify this a bush 2ft. 6in. in length and 6½in. in diameter was cast, having a wall thickness of 1¼in. This was then machined inside and outside equally, until a wall thickness of ⅜in. was obtained.

Temperature of test. Deg. Cent.	P.M.G. brass. Yield, tons per sq. in.	P.M.G. brass. Tensile strength, tons per sq. in.	Gun-metal. Tensile strength, tons per sq. in.
200	8 to 11·6	19·6	13·02
250	—	—	13·20
300	8·8	15·4	9·34
350	8·2	16·0	7·09
500	7·6	9·6	2·94

When tested to a pressure of 2000 lb. per square inch with water no sign of leakage could be detected. The metal has been also tested as a bearing metal with good results, and is stated to be easily tinned and brazed. The metal will extrude and can be used in this form for bolts, valves or valve stems; drop stampings of P.M.G. brass have also been made.

(To be continued.)

International Foundry Congress.

No. I.

IN conjunction with the twenty-sixth annual Convention of the Institute of British Foundrymen, an International Foundry Congress is being held in London this week. The technical meetings are being held at the Institution of Mechanical Engineers, but the Congress was given an official welcome by the Right Hon. the Lord Mayor of London at the Guildhall, London, on Tuesday, June 11th. Many of the overseas delegates, particularly those from America, have been in this country since May 20th, and they have been entertained by the London Branch of the Institute. Before undertaking an extensive tour of the industrial and other parts of the country between that date and June 9th, the delegates were invited to dinner by Sir Hugo Hirst. Since then the delegates have visited, as the guests of the local branches of the Institute of British Foundrymen, Birmingham and Coventry, Manchester, Oldham and district, Glasgow, Edinburgh and Sheffield, in addition to Shakespeare's country, the Derby and Matlock and the Lake Districts. The Congress was preceded on Monday, June 10th, by the annual general meeting of the Institute of British Foundrymen, when Mr Wesley Lambert was elected President for the coming year.

The accounts of the Institute are now the most satisfactory in its history, and there is little doubt that the hard work that has been put into the various branches over a long period of years is at last bringing its reward in the way of the improved status of the foundry industry and a higher level of efficiency in foundry work generally. The advent of the metallurgist and research worker has been largely responsible for this improvement, but full credit must be given to those essentially practical men who laid the foundations in the years gone by for the more recent developments. Efforts have long been directed towards providing a higher quality of recruit for the foundry industry and for better facilities for training them, but so far, it is admitted, the results have not come up to expectations. At the moment, a sub-committee is considering the most desirable method of establishing an authoritative examining body, but much work has yet to be done before a definite scheme can be expounded. At the same time, the increasing importance of the Institute is being recognised, as is shown by the request by the Board of Education Committee on "Training in the Engineering Industry" for the Council's views on "Foundry Apprenticeship and Training." The total membership of the Institute now stands at 1729, a net gain of 47 during the year.

The present Congress is the third of the series of Triennial International Foundrymen's Congresses, the first of which was held in Paris in 1923 and the second in Detroit in 1926.

The Grand Council Chamber of the London Guildhall was filled to capacity by members of the Institute of British Foundrymen and delegates from very many countries overseas, when a hearty welcome was offered to the members and delegates by the Right Hon. the Lord Mayor of London, Sir Kynaston Studd, O.B.E., who also presented two medals. The first, a gold medal, to Professor T. Turner, late Professor of Metallurgy, University of Birmingham, and a Past-President of the Institute of Metals, as a permanent souvenir of a presentation made to him two years ago, on behalf of the Institute of British Foundrymen and the British Cast Iron Research Association, on the occasion of his retirement from his professorial duties at Birmingham. Professor Turner returned thanks for this expression of approval of the work he had been able to do, and also took the opportunity to thank his American friends for having presented to him, through his son, at Detroit, nearly three years ago, their Siemens Medal.

The second medal, presented to the President, Mr. Wesley Lambert, is the Oliver Stubbs Medal, which is awarded annually to the member of the Institute of British Foundrymen who has contributed the most meritorious services during the year. This is the first time the medal has been awarded to a representative of the non-ferrous side of the industry. The Awards Committee was not influenced by the fact that Mr. Lambert was to become President, but had made the award purely on merits.

A pleasant feature of this, the first, session of the Congress was the delivery of short addresses by the heads of delegations from the various countries overseas. The countries the representatives of which spoke were America, Germany, France, Belgium, Italy, Holland, Poland, Spain, Luxembourg, Czecho-Slovakia, and Denmark.

THE PRESIDENTIAL ADDRESS.

In view of the international character of the Congress, Mr. Lambert refrained from dealing, in his presidential address, with domestic or internal matters which might concern this country only, and his address took the form of a brief review of progress in the foundry industry as he has seen it during the last three or four decades. He traced the improvements which had been effected in the design and construction of modern foundry buildings; in the various departments of the foundry, in relation both to the planning of the layout and the nature of the plant established therein, and to the accessibility of the transport yards; the better provision for the welfare of the workers; the improvements in the methods of production and in the foundrymen's art; the great progress made regarding the provision and equipment of laboratories; the ever-increasing range of materials with which the foundryman has to deal, and so on.

With regard to the materials themselves, he said that, of the progress within the last twenty or thirty years in respect of metals and alloys for foundry use, first place must undoubtedly be given to the aluminium casting alloys. The wonderful development of the aluminium casting industry was so stupendous as to seem almost incredible. When one was reminded that, only as recently as 1889, a cast block of aluminium was regarded as an object of such novel interest as to be considered worthy of inclusion as a special exhibit at the Paris Exposition of that year, whereas, to-day, the output of aluminium castings from a single foundry ran into many hundreds of tons per annum, one could perhaps pardon the use of the word stupendous when speaking of the rapid development of that branch of the foundry industry. Who, a few years ago, would have imagined omnibus wheels, pistons for big Diesel engines, crank cases for giant aeroplane engines, huge pressure vats and such-like high-duty parts, being specified as castings of light aluminium alloys? In these applications it was safe to affirm that, in the not very far distant future, even lighter alloys, mainly composed of magnesium, would become a serious rival for the engineer's favours. Already, by the use of these light alloys a saving in weight of 80 per cent. had been effected in the construction of certain parts without any diminution in strength or stability.

Special alloy steels, high-duty irons, non-magnetic ferrous alloys, high-tenacity cuprous alloys, acid-resisting irons and bronzes, and high-temperature resistant metals were only some of the bright new stars to be found in a brilliant firmament reflecting the progress on the metallurgical side of the foundry industry.

Other matters with which the President dealt were the advances made regarding the types of castings produced, the excellence of refractory materials now available, the extended use of oil sand cores, which had rendered possible the mass production of intricately cored castings, and the great advances on the laboratory side. Who could foresee, he asked, the immense possibilities of the future of the foundry industry? In such comparatively recent times as the reign of Queen Elizabeth, only seven or eight metals were known, of which only four, namely, iron, copper, tin, and zinc, were in use for the compounding of constructional—as distinct from ornamental—alloys, whereas to-day, as the result of intensive scientific research, sixty-one metals were available, and year by year one or more of the previously rarely used metals was being harnessed to the service of mankind in the form of alloys for industrial uses; the immense possibilities of the utilisation in the foundry of these later-discovered metals afforded subject matter for very fascinating conjecture. It could be seen, by the use of a simple formula, that if a complete series of binary alloys of all the known metals were compounded in merely one uniform proportion, such as 50/50, the number of alloys resulting would be 1830; if ternary alloys were made also in one definite proportion only the number of different alloys would total 35,990; and if a complete series of quartenary alloys, in one uniform proportion, such as 25 per cent. of each of the four metals constituting any one alloy, were attempted, 521,855 separate alloys would have to be produced before each of the known metals was thus proportionately employed in its own group in this series of alloys.

In conclusion, he expressed the indebtedness of British foundrymen to those nations the foundry workers, foundry engineers and research metallurgists of which had contributed so materially in raising the status of the foundry industry, and he urged the Institute of British Foundrymen to keep the flag flying high, and to contribute its quota to the continued progress of the industry.

(To be continued.)

Railway and Road Matters.

THE new West Curve at Rolleston Junction, L.M.S. Railway, is bringing so much additional traffic from the Mid-Notts. coalfield that the sidings at Beeston, between Nottingham and Trent, have to be enlarged.

THE ten o'clock "Flying Scotsman" expresses, which have been, during the winter, stopping at Grantham, York, Newcastle, and Berwick, will, beginning on July 8th, run without any intermediate stop between King's Cross and Edinburgh, a distance of 392¾ miles.

AN agreement has recently been come to between the Municipality of Nice and the tramway company for the suppression of a number of tramway lines. They are a hindrance and even a danger to motor traffic on the Riviera. Moreover, they do not pay their way. The tramways are to be replaced by motor omnibuses. In Paris it has been decided to suppress the tramways in some of the narrower streets.

THE South African Railway Adminstration has promoted Mr. A. G. Watson to the position of Chief Mechanical Engineer, in succession to Colonel F. R. Collins. Though Mr. Watson was born in the Cape in 1876 and was educated and apprenticed there, he received his main training in Glasgow, with Neilsons, between 1895 and 1900, and then returned to South Africa. He is a Member of the Institution of Civil Engineers and an Associate Member of the "Mechanicals," and in April of last year became Assistant Chief Mechanical Engineer under Colonel Collins.

THE announcement is made that, as from July 1st, the combined road and railway bridge over the river Swale, which gives communication between the mainland and the Isle of Sheppey, will be freed of tolls for road vehicles. The Southern Railway Company has, it is reported, accepted £50,000 as compensation. One-half of that amount has been furnished by the Ministry of Transport and the remainder, in equal proportions, by the Kent County Council and the six local authorities directly concerned. The maintenance and renewal is to be borne equally by the railway company and the Kent County Council.

ACCORDING to the Board of Trade returns, the value of railway material exported during the first four months of the present year was as follows, the corresponding figures for 1928 and 1927 being added in brackets:—Locomotives, £921,683 (£1,229,286, £473,316); rails, £986,549 (£1,449,007, £601,407); carriages, £619,221 (£1,019,262, £886,173); wagons, £927,509 (£1,301,736, £648,259); wheels and axles, £140,497 (£340,569, £140,946); tires and axles, £189,747 (£213,397, £132,963); chairs and metal sleepers, £152,649 (£377,256, £234,139); miscellaneous permanent way, £374,652 (£501,645, £448,623); total permanent way, £1,903,801 (£2,903,968, £1,657,390); The weight of the rails exported was 117,401 tons (168,652 tons, 70,381 tons), and of the chairs and metal sleepers, 15,478 tons (38,228 tons, 24,834 tons). During the month of April last locomotives to the value of £192,399 were shipped overseas, which included:—India, £106,301; and South Africa, £1131. For the same month the rails exported were of the value of £207,398, and included:—The Argentine, £73,855; South Africa, £43,548; India, £24,302; Straits Settlements, £12,420; New Zealand, £8934; British West Africa, £3805; and Portuguese East Africa, £1906.

A PASSENGER train was derailed at Whitehall Junction, Leeds, L.M.S. Railway, on the morning of Tuesday, June 4th. Three passengers had to be conveyed to the infirmary for medical treatment. The cause has not yet been officially stated. It was near this spot that a collision occurred on December 24th, 1877, which indicates the somewhat easy methods under which railways were worked in those days. The Midland Company had recently altered the signalling at the adjoining Woolley Junction box, and a driver, who was killed, and who was going over that length for the first time since the alterations, saw a green light. He took that to be his signal and proceeded. The light of his own signal had, however, been blown out, and what he saw was the back light of another signal. Back lights, it should be said, are given by small openings in the back of the signal lamp, and tell the signalman that the light is in. Moreover, by a blinker attached to the arm, the light is obscured when the arm is lowered, and, by the light disappearing, the signalman is told further that the arm has obeyed the lever. At that time the blinding of the light had not been introduced; a green light came in front of the back light when the arm was lowered. Thus the front light of a junction signal was green when "off" and the back light also. Green back lights were then replaced by the blinding of the light when "off."

THE fatal collision of March 9th at the north end of Darlington Station—the disaster of June 27th of last year occurred at the south end—is stated by Lieut.-Colonel Anderson in his report, issued on June 7th, to have been primarily due to the driver of the light engine and to a less degree to the two signalmen who failed to see it. The circumstances were related in this column of our issue of March 15th. Outside the eastern wall of the station are two sidings which join the down independent line. That line at once joins the down main line, and a little further north the down main line is crossed by a connection, from the up main line, which runs into the station. Two engines had used the siding above-named, and, after one had been permitted to leave, the second, accepting the signal for the first, followed. The first movement was fully provided for, and after it had been completed, it was desired to admit an express of the up main line, through the connection mentioned above, into the station. Before the signals were lowered for the express one of the signalmen went and looked where the second engine was. He thought he saw it in the siding, so reversed the siding signal and closed the points. The engine was, however, on the down main-line and foul of the connection with the station. Neither signalmen saw it there, and the express was accepted and a collision resulted, in which the front guard of the express and the fireman of the light engine were killed. The driver of the light engine was blamed for not acting to rule 55 as to sending the fireman to the box. Track circuiting is recommended.

Notes and Memoranda.

IT is estimated that the production of iron ore from the Wabana mines in Newfoundland will this year amount to 1½ million tons.

AN unusual service for a caterpillar tractor is mentioned in a recent issue of the *Caterpillar Magazine*. A water main in San Francisco burst, and liberated a jet of water about 100ft. high, which menaced adjacent buildings. The driver of the tractor, which was passing by, drew his machine over the jet and thus broke its force. When the flow of water had been stopped, the driver and tractor resumed their normal work.

A NEW lifeboat fender, invented by Mr. E. Jennings, of Liverpool, is to be tested on one of the Elder Dempster Line steamers. Two such fenders are fitted to the boat at equal distances from the bow and stern. They consist of steel rollers with rubber tires and a belt of webbing. It is claimed that whatever the position the ship is in the fenders will act so that the boat will run down the side of the ship and take the water without sustaining any damage during the launching operation. The fenders are secured inboard the lifeboat with a running chain and cleats so contrived that there is no shock when the lifeboat is launched.

THE development of television, states Dr. W. R. C. Coode Adams, in the Faraday House *Journal*, has given a peculiar interest to the element Selenium. Selenium was discovered in 1817 by Berzelius as an impurity in sulphuric acid, and is still largely prepared from that source. It also occurs native as a sulphur selenide in volcanic soil. For sixty years it was studied chemically before its peculiar light sensitive properties were announced by Willoughby Smith in 1873, thus a large amount of theoretical data concerning it exists, and a study of this might explain many of the peculiar properties and anomalies of the selenium cell.

THE contents of the latest collection of Building Science Abstracts issued by the Department of Scientific and Industrial Research, include the following items:—Stone and Mineral Earths; Clay, Clay Ware and Glass; Lime Plaster and Chemical Compositions in General; Concrete and Cement; Metal; Organic Building Materials; Paint and Varnish; Materials in General: their Properties and Testing; Theory and Design of Structures; Building Construction, Industrial Organisation and Economics; Housing and Efficiency of Buildings from the Standpoint of the User; Specialised Construction. The Abstracts may be obtained from H.M. Stationery Office, price 9d. net.

A NEW industry has been started in the Preston district by the opening of the Anglo-Cuban Asphalt and Bitumen, Ltd., works at Preston Docks, which was performed on Wednesday, June 12th, by Dr. Guillermo Patterson, the Cuban Minister. The works will deal with the raw asphalt as it is brought direct by sea from the mines at Moriel, Cuba, where the deposits in sight have been estimated at over a million tons. One of the most important products from the deposit is powdered Cuban asphalt, which is now being employed in conjunction with tar as a road binder, and also as a surface dressing material, the effect of which is to prolong the life of the tar. A new type of spraying machine for dealing with the asphalt has been designed.

A PROCESS, by which hydrocarbon oils and organic liquids are produced from coal through the medium of water gas, has been announced by Fischer in Germany. Recently, Audibert and Raineau have submitted to the French National Bureau of Liquid Fuels a comprehensive report of work on the development of this process. Although the catalysts necessary to this process have not yet been developed to the point of commercial application, it has been shown that the process holds considerable promise. For example, from 1000 cubic feet of water gas, 1 gallon of organic liquids and 100 cubic feet of gaseous hydrocarbons can be produced. The organic liquids consist principally of hydrocarbons and alcohols. The gaseous hydrocarbons contain a large proportion of methane.

THE results of a study of the major work on specific heats of gases at high temperatures are presented in Technical Paper 445, by E. D. Eastman, recently issued by the United States Bureau of Mines. In this study a critical review of the more important individual investigations was made. Reasons are indicated for the exclusion from final consideration of certain of those researches purporting to be of high accuracy. The results of many of the remaining works are recalculated from the original data by methods that largely eliminate errors characteristic of the methods of measurement. In addition, the recalculations and graphical presentations make apparent the exact contribution of each research, limited to its own range and uninfluenced by others, and permit independent appraisal of the results. Among the gases considered are oxygen, nitrogen, hydrogen, water vapour, carbon dioxide, hydrogen chloride, chlorine, carbon monoxide, nitric oxide, sulphur dioxide, hydrogen sulphide, ammonia and methane. Copies of this paper may be obtained from the Government Printing Office, Washington, D.C., at a price of 10 cents.

TALKING motion pictures unite two long lines of scientific development; first the recording and reproduction of sound affecting the sense of hearing, and secondly, the recording and reproduction of visual objects affecting the sense of sight. The rapid progress now being made in the development of these films, states the Faraday House *Journal*, is due to the intensive research being made on the fundamental physical laws affecting them and to the development of the necessary apparatus which is continuously modified with each advance in knowledge. When the electric sound projector systems are working in a picture theatre they are under constant engineering supervision so as to get the best results. The best arrangement for each theatre has to be found by experiment. Its acoustic characteristics have to be mapped out. Sections of the auditorium may give echoes or produce interference and noises from an extraneous source may detract from its acoustic qualities. Remedies complete or partial have to be found. Old-fashioned engineers would be astonished at the ability shown by the younger generation in handling these and similar problems in connection with "talkie" films.

Miscellanea.

A LARGE plant for the manufacture of hydrogen and oxygen is to be put up at Hamilton, Ontario.

A PLANT for the briquetting of lignite and the manufacture of pulverised coal is to be put up in the Estevan area of Saskatchewan.

THERE are now fifty-three firms operating aircraft in Canada, and 75,285 flights were made in 1928, as compared with 16,748 in 1927 and 4755 in 1926, according to the latest returns. The mileage was 1,557,917 in 1928, compared with 209,583 in 1927 and 30,290 in 1926.

THE Tokio Electric Light Company is considering the erection of a steam power station having a generating capacity of 150,000 kW. The station will be equipped with two generators, one of 50,000 kW and the other of 100,000 kW. A high-pressure steam plant will be installed.

THE centenary of the London omnibus, which first plied for public hire on July 4th, 1829, will take place on Saturday, July 6th. The London General Omnibus Company, in co-operation with Thomas Tilling, Ltd., is making arrangements for a procession of the various types of horse and motor omnibuses which have been used in London for the past hundred years.

IT was reported recently to the Ripon Rural District Council that the residents of Bishop Monkton had raised objections to the erection of overhead cables for the provision of electric lighting to the village, and that the ratepayers were willing to pay the additional cost of laying them underground. The Council accordingly has given consent for the work to be done in accordance with the wishes of the villagers.

THE Ontario Hydro-Electric Power Commission intends to construct during the current year no less than 1071 miles of primary electrical distribution lines, bringing the total mileage to 5000. The new lines to be placed in operation this year will serve an additional 6000 more rural customers at a capital cost of approximately 2,500,000 dollars. Of this year's construction schedule, 866 miles are in the south-western peninsula, 63 miles in Northern Ontario, and 142 miles in Eastern Ontario.

RETURNS recently rendered to the Electricity Commissioners show that the amount of electricity sold to consumers by authorised undertakers in Great Britain in the year ending December 31st, 1928, was 7602 million units, representing an increase of 752 million units, or about 10·9 per cent. on the figure for the previous year. Over a period of six years since 1922 the annual sales of electricity to consumers by authorised undertakers in Great Britain have increased at an average rate of about 660 million units per annum.

AN increase of more than 10 per cent. of tonnage during the year 1928 is announced in the report presented to the annual general meeting of the Suez Canal Company this week. The tonnage passing through the canal during the year was 31,905,902, showing an increase of nearly 3,000,000 tons over 1927, which was itself a record year. In order of importance by nationality the British flag still comes first, with 56·8 per cent. of the total. It is followed respectively by Holland, Germany, France and Italy. German shipping increased by over half a million tons in the year.

THE *Board of Trade Journal* states that, according to statistics published in the Preliminary Report on the Mineral Production of Canada during 1928, the Dominion is the world's fourth most important producer of copper, with every prospect of becoming the third greatest source of the red metal within the next eight or ten years. At present Africa also produces more copper than Canada. Producing 201,940,172 lb., or 100,970 tons, in 1928, Canada showed an advance of more than one-third over 1927. British Columbia was responsible for more than half of the copper produced.

THE world's prodction of tungsten has more than doubled during the last four or five years and amounts to, roughly, 13,500 tons per annum. The proportion produced in the British Empire is approximately 2800 tons, or about 17 per cent. The chief source of supply is China. The situation has become interesting on account of increasing trade requirements, and this has been largely reflected in the more attractive price which has been secured within the last year or so. There is little doubt that mining operations in Burma, Malaya, South Africa and Cornwall will be stimulated as a result.

THE Middle Level Commissioners are to erect a large pumping station and outfall sluice in the Fens at St. Germans. The contract for all the machinery has been let to the Premier Gas Engine Company, Ltd., of Sandiacre. It includes several crude oil engines, each developing 1000 horse-power, coupled to pumps made by Gwynnes Pumps, Ltd. The pumps are to be of the horizontal centrifugal pattern, the suction inlet of each being 102in. diameter, and the weight of each is estimated to be about 60 tons. The constructional work, including the erection of the new sluice, will be carried out by direct labour, and will provide work for two years for men from the depressed areas.

BOTH the President of the American Iron and Steel Institute and the President of the Steel Corporation suggested recently in positive terms that the steel industry should have a moratorium in new construction. Mr. Schwab said that all steel men knew how the industry had paid dearly for over-expansion in the past, and that many industries in the United States are still suffering from war-time expansion, while it is but lately that the steel industry has caught up. Mr. Farrell made the significant statement that in the past five years the Steel Corporation had increased its open-hearth capacity by only 1,700,000 tons, doing that by rebuilding and improving old plant, whereas independents had increased their capacity by 8,250,000 tons. Mr. Schwab's contention that the industry has had excess capacity until lately is supported, says the *Iron Age*, by the statistical data that relative to capacity ingot production has ranged from 69 per cent. in 1924 to 83 per cent. in 1923, 1926 and 1928, the six years averaging an engagement of 79 per cent. of the capacity existing from time to time.

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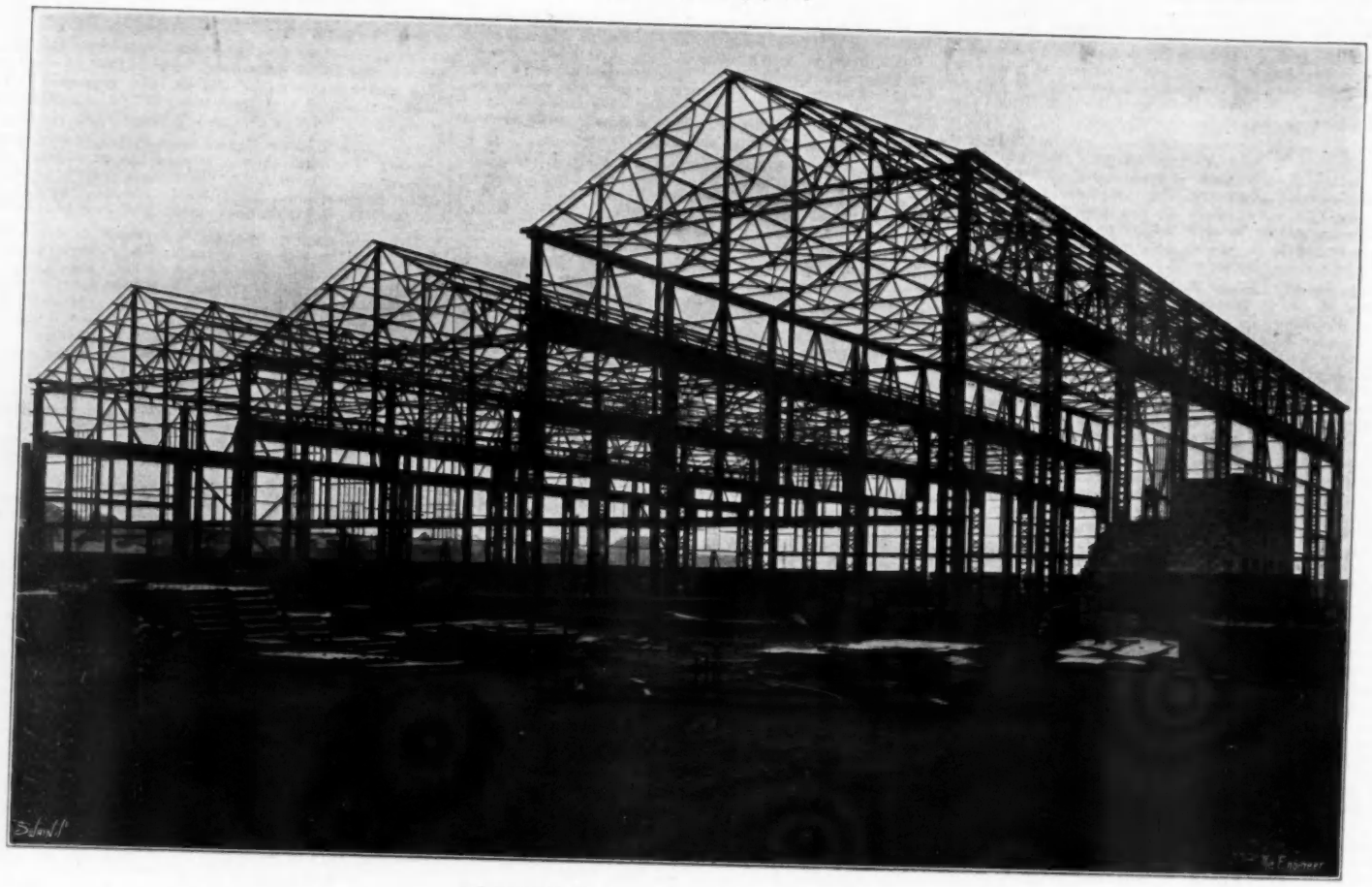

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DEATH.

ON Tuesday, June 11th, at Monthey, Switzerland, Mr. THOMAS BLACKWOOD-MURRAY, D.Sc., M. Inst. C.E., M.I.E.E., late Chairman and Managing Director of the Albion Motor Car Company, Ltd., Scotstoun, Glasgow.

THE ENGINEER.

JUNE 14, 1929.

The Indus and its Five Tributaries.

A TRIPARTITE agreement between the Government of India and the Punjab and Bombay Governments, compelling the Punjab to go somewhat slower with its future programme than it desired, does but draw attention to the wonders that have been, and are being, achieved by the British irrigation engineers working in Northern India. Within India as a whole twenty-eight million acres of very valuable crop have been added to the cultivated area by means of great Government works, brought into existence since the British connection. It is, however, in the Punjab and Sind that the most beneficial action has taken place. There have always been scratches on the margins of the rivers which have led off some of the flood waters in the summer to the lands adjoining, but the total area cropped in the Punjab soon after annexation in 1848 amounted to less than 200,000 acres. Even among the inundation canals the engineers have worked marvels, so that the figures for these canals have risen to nearly two million acres, while in Sind, from small beginnings, three and a quarter million acres are now cropped every year. But these things are as naught to the work done by the perennial canals. The name Punjab means the land of the Five Rivers, and the engineers have shown what the land could do when the waters of the five rivers were poured upon them. They have fettered the rivers with powerful weirs and led the gold-producing fluid from them on to land formerly desert. Apart from the inundation area already mentioned, eight and a half million acres are cultivated by the great perennial canals. Of this vast area three quarters of a million depend on the Jumna, a separate river that flows into the Bay of Bengal, but the Indus and its five tributaries can be said to irrigate thirteen and a quarter million acres already.

There are at present in progress two gigantic schemes, one in the valley of the Sutlej and the other on the Indus at Sukkur. Each of them will deal with over five million acres annually. Four million acres, instead of as now getting fitful irrigation for four months from inundation canals, will be secured for better crops, whilst six and three-quarter million acres will be irrigated for the first time. Thus the Indus system will soon be responsible every year for twenty million acres of crop worth on a moderate estimate £80,000,000. But there is much yet to be done. In Sind there is a belt of country north of Sukkur, dependent on the inundation canals, which might be greatly improved, and another weir at Kotri would safeguard a large area at the end of the Sukkur Barrage irrigation. According to a distinguished Bombay engineer, four million more acres might be brought under cultivation, while the waters of the Indus would suffice to give all Sind a double crop, such as Egypt gets from the Nile. According to the evidence of the Chief Engineer of the Punjab before the Agricultural Commission, that province has matured new projects to cover another area as large as Egypt and the Sudan put together, and to add five and a half million acres more to the annual cropped area. In this list of proposals there is only one storage dam, but it is now known that there are some thirty and more sites where lakes could be created within the Himalayas, and these will come into existence some day. We may mention that the great hydro-electric works now under construction may add two and a half million acres of cultivation by lifting water on to land not now dealt with by canals. Hence the prosperity that may yet be achieved by means of the Punjab and Sind rivers forms a very dazzling prospect. For the moment Sind is anxious for the safety of its great scheme under construction, and certainly one that will command 7,500,000 acres and irrigate 5,300,000 every year is not one to be put in jeopardy. It is therefore of interest to consider what has been done with each river and what is still proposed. The Indus, with a minimum of 19,000 cusecs and a maximum flood of one million cusecs, has in the past merely been used by the inundation canals of the summer to water 3,250,000 acres in Sind and some three-quarter million acres in the Punjab. Within a short time, from the 4725ft. long barrage within the gorge of Sukkur, five great and two small canals will take off 22,656 cusecs when water is scarce and 45,926 cusecs from June to September. The Punjab has for nearly thirty years considered a scheme for taking off a great canal from Kalabagh, and in 1901 entered into various agreements with the inhabitants of the desert that lies between the Indus and the Jhelum. A project has been evolved to take 5973 cusecs during the winter and 14,000 cusecs in the hot weather for the irrigation annually of 1,852,000 acres out of a vast area of just five million acres.

While all but a small part of the Indus has till now flowed away to the sea, the five tributaries have been used to an extraordinary extent so that their beds are practically all dry during the winter months, while that of the Sutlej should send nothing down below the weir at Islam for nine months with the exception of an occasional freshet. These rivers, like the Indus, vary in size tremendously. The Jhelum, with an absolute minimum of 4000 cusecs, has had a flood of 577,400; the Chenab, with 3884, has gone up to 700,000; and the little Ravi, once down to 1272, has, with 300,000, done damage at the very outskirts of Lahore. The Sutlej, with a minimum of 2057, sent down with the aid of the Beas, which is smaller, a volume of over 400,000 that nearly smashed up the Suleimanke weir in the making and necessitated a revision of the size of the Ferozepore weir. The Punjab canals are not, of course, based on the minima. They are designed to take most of the water likely to flow in the winter and one and a half to twice that amount in the hot weather. The Triple Canals scheme, as is well known, linked the three rivers Jhelum, Chenab and Ravi together, which now with 52,562 cusecs of perennial water are responsible by means of six great canals for the irrigation of six million eight hundred thousand acres annually. Even so, inundation canals, and the weir-controlled Sidhnai, running for six months only between them, take off another 10,500 cusecs and add half a million acres of cultivation lower down these rivers. And still the engineers are not sated. They hope by various improvements and extensions and by a hydro-electric pumping scheme to add 300,000 acres more, and they have yet one large project, the Haveli scheme, in view. The Punjab

rivers run in shallow beds below the surface of the lands on either side, and therefore part of the water poured on to the cultivated country drains back to the rivers lower down. It is proposed to place a weir at Haveli below the junction of the Chenab with the Jhelum, to take off 8000 cusecs in the summer, and also 1250 cusecs of ooze water in the winter, and thus with the aid of the Sidhnai weir and a little juggling with the Lower Bari Doab Canal to add another 714,000 acres to the work covered by the Jhelum, Chenab and Ravi. The Sutlej has had since 1882 the Sirhind Canal, which with 8828 cusecs irrigates 1¾ million acres and brings wealth to several Indian States in addition to the Punjab. With the aid of its tributary the Beas it is under process of being bound with three weirs in addition to a fourth where it joins the Chenab, and with canals which will take from 7532 to 48,516 cusecs when available, will cultivate 5,100,000 acres annually within the Punjab and the States of Bahawalpur and Bikanir. The flow of the river will be utilised even more than the Chenab trio, but it is on the Sutlej that it is proposed to start the first great impounding dam. By holding up the melting snow and the torrents of the monsoon before they can escape from the confines of the Himalayas it is proposed to stop part of the surplus which now flows uselessly to the sea, and by issuing it during the winter to add nearly 2,500,000 acres to the cultivation of the Punjab, the Sikh States and Bikanir.

The recent conference has decided to allow the Haveli scheme to proceed as long as the Punjab does not take more than 1250 cusecs in the winter. The Bhakra Dam on the Sutlej may also be proceeded with, provided that two Superintending Engineers from Sind and the Punjab jointly agree to fixing such a period for holding up the water that there can be no possible damage to the inundation canals of Sind. This will be an easy matter. It has, however, been decided that the Thal Canal shall not be proceeded with for some years, so that the Sukkur irrigation can be fairly tested. There is no real harm in this decision, because the other schemes will absorb the energy of all the engineers to be released from the Sutlej Valley project, and the desert areas requiring cultivators elsewhere have yet to be filled. It is, however, clear from the way the Punjab rivers manage to fill canals six times the size of their absolute minima that the nervousness of Sind is not likely to be justified, and that before long the whole of the prepared programme will be undertaken. It is one marvellous to contemplate, and still behind it lies the possibility of drying up the rivers still further by the aid of many more storage dams. Indian engineers in steadily increasing numbers are becoming skilled and some are rising towards the top, but it is the knowledge, the experience, and the energy of the British that has created this annual wealth, changed the value of land from nothing to great sums, and has enabled people in increasing numbers to live on a scale unimagined by their forefathers. Great Britain has also gained, for the trade that is done through the port of Karachi both of imports and of exports, is to the benefit of the country which sent out the engineers. It is believed that the aim of Mr. J. H. Thomas, on behalf of the Labour Government, is to decrease unemployment in this country by pressing on developments throughout the Colonial Empire. The achievements in the Punjab may well stimulate him towards well-thought-out efforts.

The Propulsion of Ships.

MANY factors are combining to make the present period one of extraordinary fascination to those of a mechanical turn of mind, whether they be professionals or amateurs. In almost every form of transport by land, sea, and air, new methods are either in use, under test, or in contemplation. And nowhere, we venture to say, is the march of progress more rapid than in the domain of marine propulsion. Hardly a month passes without bringing some interesting item of news bearing on this subject. The contest between the steam engine in its manifold forms and the internal combustion motor is raging with unabated energy, yet the issue is still in doubt. Ships of unprecedented tonnage, to be equipped with one or other of the rival systems, have already been or are about to be ordered. It is an understood thing that the new White Star liner "Oceanic" of 60,000 tons, now on the stocks at Belfast, is to have Diesel-electric drive, a decision involving unheard-of developments in this method of propulsion, hitherto tried afloat on a very modest scale. Further, there are definite forecasts of the building of one or more great Cunard liners, even larger than the "Oceanic," which rumour credits with high-pressure steam turbines up to 160,000 S.H.P. Turning from plans to actualities, we find a German liner, the "Bremen," on the eve of making a bid for the "blue riband" of the Atlantic; the twenty-two year old "Mauretania," and the younger but by no means juvenile "Berengaria," blithely breaking their own speed records, and the French Navy claiming speed supremacy by virtue of the 39·93-knot trial run of its new destroyer "Valmy." Nor must mention be omitted of the P. and O. turbo-electric liner "Viceroy of India," which lately completed a most successful maiden voyage from Tilbury to Bombay and back. Besides these outstanding events, there are others which, if less sensational, are of equal significance from the engineering point of view, such as the launch on the Clyde last month of the "Berwindlea," the first vessel to be specially designed for burning pulverised coal, and the building of a large German warship to be fitted with internal combustion engines, in which the normal weight per unit of power has been reduced to an almost unbelievably low figure. Sluggish indeed must be the imagination which is not stirred by these happenings.

Since we last wrote on the subject of great ocean liners Lord Kylsant, the chairman of the White Star Company, has dropped a broad hint on which we base our assumption that the "Oceanic" is to be driven by the Diesel-electric system. This, if confirmed, represents one of the boldest decisions of its kind ever taken. How bold it really is cannot be determined until the projected speed of the ship is revealed. Even if no higher velocity than 25 knots is aimed at, an output of 80,000 H.P., or thereabouts, will be required. This is so far above the power of the largest Diesel-electric marine plant built up to the present that no comparative data are available. Not for an instant would we suggest that the choice of the "Oceanic's" machinery is reckless or injudicious. On the contrary, we know that a shipowner of Lord Kylsant's experience would not take such a step unless he was absolutely satisfied as to its wisdom. Nor, we might add, is the sudden development of a new and comparatively untried method of ship propulsion an event without parallel in engineering history. Twenty-three years ago the "Mauretania" and "Lusitania" were designed for turbine machinery of 75,000 S.H.P. This was not only almost double the power of any plant installed in a ship up to that date, but considerably more than double the power of any turbine engines then in existence. We recall very clearly the gloomy predictions that were current at the time. Machinery breakdowns would be frequent, it was prophesied, and if by some miracle they did not occur, the new liners must infallibly shake themselves to pieces, since no vessel built by man could for long endure the frightful vibration of such high-powered machinery. But the builders of the ships, on the one hand, and Sir Charles Parsons on the other, knew what they were about. Between them they produced a pair of ocean liners which established a standard of all-round efficiency that has yet to be surpassed. And that was nearly a quarter of a century ago. Passing from merchantmen to men-of-war, due credit is given by British engineers to their French *confrères* for the brilliant performance of the destroyer "Valmy," which, as mentioned above, attained on trial a maximum of 39·93 knots. If the vessel had her normal equipment on board, her speed constitutes a world's record, though it was closely approached ten years ago by H.M.S. "Tyrian," one of the Yarrow design of destroyers, which reached a maximum of 39·72 knots, and the Thornycroft destroyer "Teazer," which touched nearly 40 knots at Skelmorlie. Both these boats ran their trials with complete armament and equipment on board. Whether the French destroyer will be able to maintain her trial speed of 39·93 knots in deep water and fully loaded remains to be seen. The uniform success attending the trials of French naval vessels built since the war will not have escaped notice. Not so many years ago it was regarded as something rather remarkable if a French warship reached her designed speed on trial. This was in no way the fault of the ship constructors or engine builders. The blame rested with the naval authorities, who often insisted on modifications being made in the design of a ship after she had been laid down. Since the war this pernicious practice appears to have been abandoned, so that French designers and engineers have now a real chance to show what they can do. They have every reason to be proud of the result. Without a single exception, we understand, all the post-war cruisers and destroyers have exceeded their contract speeds, and in spite of arduous service they have proved remarkably free from engine-room troubles. But while cordially recognising the successes of continental shipbuilders and machinery designers, we are confident that, given the opportunity, British skill and workmanship will retain for this country its traditional pre-eminence in the production of high-speed ships. Incidentally, with new and drastic proposals for naval armament reduction looming ahead, it seems probable that international rivalry at sea will in future be more or less confined to mercantile craft.

Writing in the latest issue of *Schiffbau*, Herr Hermann Hildebrandt, a well-known shipbuilder, makes some interesting observations on the giant liners now on the stocks or soon to be laid down. Applying the Admiralty formula to the reputed dimensions and horse-power of the new Cunarders, he finds that on the data given they should have an average speed of 30 and a maximum of 31·75 knots, the latter being attainable in smooth water. It should be remembered, however, that forecast of the dimensions and engine power of these vessels are unofficial and not yet confirmed. We are pleased to find Herr Hildebrandt emphasising the peaceful and friendly nature of the contest for the "blue riband" of the Atlantic, a contest which, as he puts it, represents "the noblest form of sport." That the great liner companies at home and abroad, in deciding to build ships of unparalleled size, speed, and cost, are not actuated by sporting motives, goes without saying. Nevertheless, the public finds something decidedly thrilling in the prospect of these splendid ships engaged in an ocean race for an imaginary trophy. Herr Hildebrandt, who seems to think it necessary to defend his country's action in building the "Europa" and "Bremen," scouts the idea that their construction gave the signal for a fierce struggle for supremacy on the North Atlantic route. We can assure him that, on this point, the only sentiment entertained in this country is one of admiration for the enterprise which Germany has shown in building such fine vessels. Nor do we doubt that the career of the "Oceanic" and the other epoch-making British liners now in contemplation will be watched abroad with friendly interest. Within the realm of science there is no room for petty jealousies. While Great Britain may reasonably claim to have been the pioneer in the development of the ocean liner, she owes not a little to the genius of constructors and engineers in other countries, just as they have profited by British genius and experience. The joint endeavours of Great Britain and Germany, in particular, have been mainly responsible for progress in the design of high-speed ships and their machinery. It was the success of the British vessels "Campania" and "Lucania," built in 1893, that encouraged Germany four years later to construct the "Kaiser Wilhelm der Grosse"—which established a new speed record—and, subsequently, the "Deutschland," "Kronprinz Wilhelm," and "Kaiser Wilhelm II." all of which were famous ships in their day. Thanks to this fleet, Germany remained in unchallenged possession of the "blue riband" for nearly ten years. Then, in 1907, it was regained by the "Mauretania" and her sister. It has remained in British hands ever since, though but for the intervention of the war and the consequent dislocation of German shipping plans, it is more than possible that the "Mauretania" would long since have had to measure herself against formidable rivals from Bremen and Hamburg.

The Institution of Civil Engineers' Conversazione.

THE annual conversazione of the Institution of Civil Engineers took place on Wednesday evening, June 12th, and was held at the house of the Institution, Great George-street. As befitted the occasion, the entrance hall and the great hall were very tastefully decorated with flowers. A large company of members and guests attended and were received by the President, Sir Brodie H. Henderson, K.C.M.G., C.B., and Lady Henderson, who were supported by members of Council. A programme of vocal and instrumental music added pleasure to the evening, and three interesting lantern lectures were given. Professor Percy Hillhouse spoke on "Japan and the Japanese," an appropriate subject in view of the forthcoming World Power and Engineering Conferences in Tokio; while Captain J. S. Irving gave a talk on "World's Speed Records and their Value in Engineering Research." Colonel the Master of Sempill discussed "The Light Aeroplane in the

Making and in Use." Various exhibits of engineering and scientific interest were arranged in the library and upper council room, and in what follows a short description of some of them is given.

Dr. C. H. Lander, the Director of Fuel Research, had an interesting and instructive exhibit illustrating a recent investigation designed to correlate the opacity of smoke with its composition. The principal experimental apparatus employed was an adaptation of the well-known Féry pyrometer by which smokes of varying degree of blackness could be assigned smoke intensity numbers. Simultaneously with the determination of the number, a sample of the smoke was withdrawn from the chimney for analysis. The smoke numbers were chosen as proportional to the weight of smoke impurity deposited on a filter in pounds per ton of fuel burnt. A light smoke is one of about No. 4 intensity. Nos. 8 to 10 represent a medium smoke; while Nos. 14 to 16 would be described as black smoke. A No. 14 smoke was found to contain about 60 lb. of smoke particles per ton of fuel burnt. On detailed analysis of the smoke particles, it was found that as the smoke increased in density the proportion of it which was ash decreased in quantity in a straight line law when plotted against the intensity numbers. On the other hand, the tar content increased very rapidly with the density of the smoke. An examination was made of the available heat lost in the smoke. In a No. 4 smoke the particles were found to carry away about 2·5 per cent. of the total heat in the fuel; in a No. 8 smoke about 6·5 per cent.; and in a No. 16 as much as 9·5 per cent. It may be added that the continuous emission of a No. 12 to 14 smoke is not at all uncommon from factory chimneys. The apparatus used for the research is too complicated to use in every-day practice for the determination of smoke intensity numbers. The Fuel Research Station has, therefore, developed a simple series of variously tinted smoke screens, and has correlated the indications which they give with those obtained from the same smokes by means of the Féry pyrometer apparatus.

Mr. Frank Mercer exhibited a race-timing chronograph, in actual fact the precise instrument used to time Captain Malcolm Campbell's recent motor car speed record attempts in South Africa. At the start and finish of the measured distance the car runs over a rubber cushion which, when compressed, establishes an electrical contact, and so causes current to flow to the magnet of an ink pen. The pen makes a mark on a strip of paper drawn beneath it by means of a clockwork motor. A chronometer with an electrical contact in its escapement operates two other pens which mark the paper at seconds intervals. The speed of the paper can be varied, but at the minimum it is such that the seconds marks on it are about 2in. apart. To determine the time occupied in traversing the measured distance, the number of whole seconds between the "start" and the "finish" marks is counted, and to this number the fraction of a second at each end of the record is added. The fractions are determined by directly scaling the lengths on the paper by means of a vernier under a magnifying glass. We were glad to learn that the makers of the instrument do not lend their countenance to its use as a means of determining motor car speeds to five or six places of decimals.

Professor S. M. Dixon exhibited a collection of wooden and steel pit props which, if it did nothing else, impressed the visitors with the number and variety of steel props which are now in use or on the market. Some of the steel props were simple rigid lengths of metal which, while stronger than wooden props, failed to duplicate that valuable property of wooden props, the yielding which they exhibit under excessive load. Early types of steel props were disliked by the miner because the absence of this yielding deprived him of the familiar information given by a wooden prop when it required assistance. Trouble, too, arose because of the difficulty encountered in removing a steel prop under load. In the newer designs of steel props, such as the Butterley, Newsarre, Tait, Berrisford, "S.F.," Mureaux, Sarre, and Schwarz, a yielding characteristic is given by fitting their ends with plugs of wood or by embodying wooden wedges in their design, while facilities for withdrawing the props when under load are provided by, in some cases, fitments of quite an elaborate nature.

Professor W. E. Dalby exhibited an equipment designed to demonstrate the effect of the Hammer blow applied by a locomotive to a bridge, as discussed in the Bridge Stress Committee's recent report. Professor Dalby's "bridge" was a flat steel strip, 2in. wide by ¼in. deep, laid across supports about 6ft. 6in. apart. At the middle of its length the strip carried an unbalanced rotary weight wihch could be driven at various speeds. The natural period of oscillation of the strip was 108 vibrations per minute. When the unbalanced weight was driven at 108 r.p.m. the hammer blow applied by it to the strip was ½ lb. Applied statically, a load of ½ lb. at the centre of the span caused the strip to deflect by 0·05in. When, however, the hammer blow was applied repeatedly with the natural period characteristic of the strip—that is, when the unbalanced weight was driven at 108 r.p.m.—the deflection of the strip built itself up until it amounted to 1¼in. Such a deflection is equivalent to that which would be caused by a static load of 17 lb. concentrated at the centre of the span. This apparatus was shown by Professor Dalby at his Thomas Lowe Gray Lecture before the Institution of Mechanical Engineers and was illustrated in our issue of December 7th, 1928.

Mr. H. Glaser showed samples of lead-covered steel glazing bars for use in glass roofing, suitable for fixing to roof structures in wood, steel, or concrete. The steel core of these bars is of inverted T section, with the ends of the horizontal arm turned downwards and upwards to form channels for conducting away moisture condensing on the underside of the glass. An extruded lead mantle is drawn over the steel core, and is then rolled closely into contact with it. On each side of the vertical arm of the T the lead mantle is formed with a flap which, when the glass is in position, is pressed down against the outside of the pane and holds it in position without the use of putty. At their lower ends the bars are turned up and round the turned up ends lead is cast to form a stop to prevent the glass sliding downwards. The method employed of fixing the glazing bars to the roof structure is such that at no point is the lead mantle pierced. We were informed that the use of these lead-covered glazing bars in place of glazing bars of wood does not require any increase in the scantlings of the roof structure.

Mr. John L. Hodgson showed a combustion efficiency meter, a gasholder height indicator, and a balanced recorder for low-pressure air and gas flows. The combustion efficiency meter was provided with indicating pointers, which showed the steam flow from a boiler, the suction in the combustion space, the furnace exit temperature, and any deviation from the ratio of the air flow required for combustion to the steam flow produced, which it might be desired to maintain. In the gasholder height recorder—also applicable to determining the depth of liquid in a distant tank—two scales are provided, one of which shows each 3in. of motion—or depth—and the other each 10ft. or other suitable distance. The apparatus is electrically operated. Its indications are claimed to be independent of variation in the battery voltage, only a single wire and an earth return are required for each scale, and means are provided which enable the line wire resistance to be checked from the receiving end before a reading is taken. The balanced recorder for air or gas flows was designed to record down to one-twentieth of the full flow on an equally spaced flow scale.

Mr. Hodgson also exhibited by model and diagram a scheme for damming the Straits of Gibraltar, whereby the level of the Mediterranean would be lowered by natural evaporation, and, as a consequence, a head from the Atlantic would be available for the generation of power. If, says Mr. Hodgson, the Mediterranean were lowered 2000ft. by evaporation, and if the difference between the evaporation and the rainfall over the 950,000 square miles of water area which would remain after its level had been so lowered was about 5ft. per year, then one thousand million theoretical horse-power would be made available, or about five times the present estimated water horse-power of the world. The dam at Gibraltar would be about 10 miles wide at the top and would be provided with a ship canal and locks. Precautions would be taken to guard against the breaching of the dam by earthquake.

Dr. H. S. Hele Shaw and Mr. T. E. Beacham exhibited a compressed air motor and a model illustrating a device for the transmission of power at a variable speed by rolling friction. The air motor is a development of the Hele-Shaw variable high-speed pump, and is claimed to be an efficient low-pressure machine running at a high speed. The motor is being applied in mines for haulage purposes, and for driving centrifugal pumps. A single lever controls the direction of rotation and the speed of the motor. The same lever can be used to stop the motor and to apply an air brake. In the variable mechanical transmission model exhibited, use is made of the rolling contact between two hard steel surfaces. It is too early yet to describe this invention in detail, but it may be said that the particular manner in which the hard rolling surfaces are employed eliminates slip entirely, so it is claimed, while there is an entire absence of wear even with hard work.

Mr. A. E. Kidner showed a 2-ton lifting truck entirely constructed of steel sections and steel castings. The lifting table was raised with an inclined plane movement by means of a system of radial links. The leverage provided by the lifting handle was 35 or 40 to one.

Among other exhibits we noticed one illustrating the properties of heat resisting, non-corrodible and other steels (Sir R. A. Hadfield); some specimens of copper tubes, sheets and wires made by an electrolytic process (S. Cowper Coles); an early ½-kilowatt turbo-dynamo set, a 20in. split mirror and a 90 cm. search-light mirror (Sir C. A. Parsons); a new type of infinitely variable gear (F. W. Davey); and an echo-sounding machine (R. L. Quertier).

A NEW mining and technical college is to be built at Barnsley at a cost of £79,660. Of this sum the Miners' Welfare Fund has allotted a grant of £10,000 towards the cost of building and £5000 for equipping the college, of which sum £960 has been already spent on apparatus and £4040 reserved for the purchase of equipment. An application is being made to the Ministry of Health for the sanction to raise a loan of £69,660.

George Stephenson's Birthplace.

ALL over this land of ours, in big towns, in cities, in villages, may be found houses and cottages celebrated as the birth-places or dwelling-places of famous men and women. Amongst them is the little cottage at Wylam-on-Tyne, in which George Stephenson was born nearly 150 years ago. It stands beside the railway, but is off the beaten track, and is only known as a shrine to those who have devoted themselves to the history of engineering. Indeed, it stood in real danger of being forgotten entirely, and we rejoice that it has been saved from that fate by the attachment of a bronze memorial tablet to its venerable walls. The plate, which we illustrate herewith, was designed by Mr. Herbert Maryon and executed in Newcastle, and was unveiled on Saturday last by the Lord Mayor of Newcastle-on-Tyne before a party which included the Presidents of the Institution of Mechanical Engineers and of the North-East Coast Institution, the two bodies which have borne the cost of the presentation, several Members of Council of the same Institutions and representatives of the London and North-Eastern and the

London, Midland and Scottish Railways. It is very largely due to the enterprise of Sir Archibald Ross and his veneration for a famous engineer that the tablet has at last been placed, where all men may read, upon a cottage which is surely amongst the most famous in all industrial history. Stephenson was not the inventor of the locomotive—Trevithick has a far better claim to that proud title—but he brought the locomotive to a position of real utility to mankind in general, and he was the first of the great railway engineers. It is nearly a hundred years ago that the "Rocket," the product of his little works, carried off the prize at Rainhill, and it is very fitting that a representation of that engine should appear upon the tablet at this centenary. The cottage in which Stephenson lived when the "Blucher" of 1814 and other engines for the Killingworth Colliery were built, is already marked with a tablet over the portal, but it has been left to the present year—a very appropriate one—to do honour to the humble cottage in which the great pioneer was born.

Obituary.

A. W. ROBINSON.

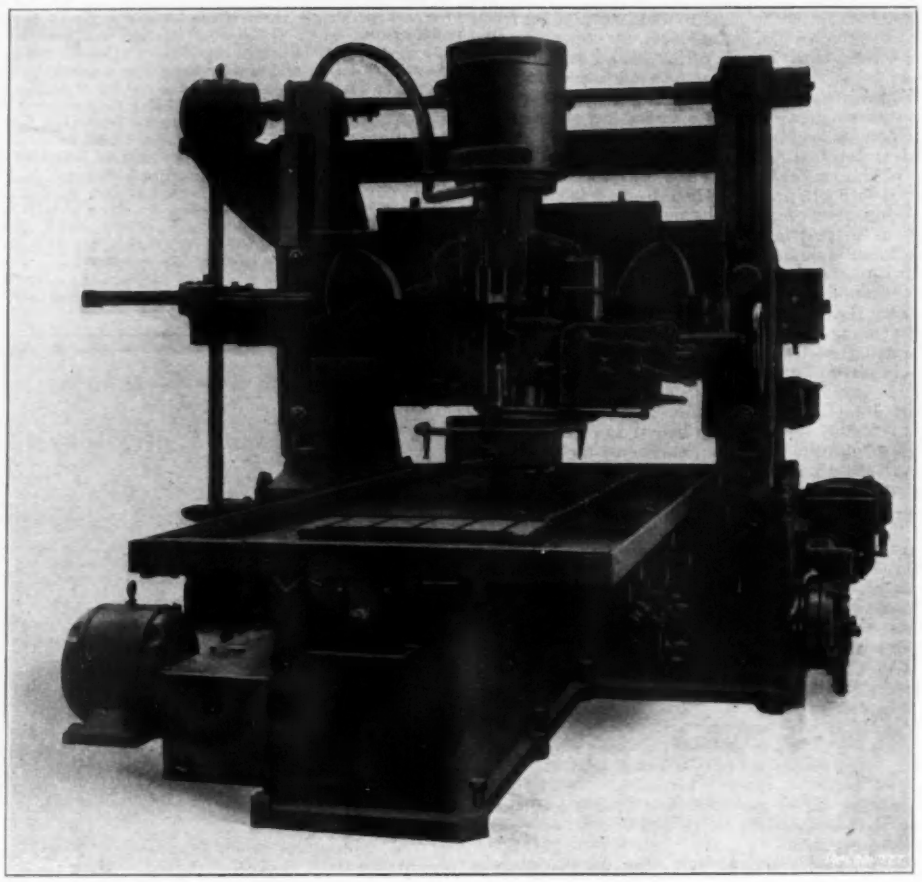
A MESSAGE from Toronto announces the death of Mr. A. W. Robinson, of Upper Melbourne, Quebec, as having taken place in Montreal on May 23rd. Mr. Robinson, who was in his sixty-ninth year, was born at Collingwood, Ont., and went to Montreal in 1877, where he was engaged in work on the harbour and the St. Lawrence River Ship Canal. In 1885 he became designer and managing engineer for Bucyrus Company, of South Milwaukee, Wis., where he developed the American type of steam shovel, and designed the first large shovel for mining iron ore. Returning to Canada in 1900, he was engaged as consulting engineer by the Canadian Department of Public Works, and also served in a similar capacity for the Egyptian Government, and in connection with various harbour works in China and India. He designed and built more than 400 dredging machines of various types, and developed the Robinson rotary cutter for hydraulic dredgers and stiff clay soils. The Canadian Government dredger, designed by him and fitted with a cutter of this type, made a world's record for output. He was a member of the Institution of Civil Engineers, of the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the Engineering Institute of Canada.

DANIEL GOEDKOOP.

In the death of Mr. Daniel Goedkoop, formerly the managing director of the Netherland Shipbuilding Company of Amsterdam, the Dutch shipbuilding industry and the Port of Amsterdam loses one of its pioneers. Mr. Goedkoop died at Amsterdam on May 29th, at the age of seventy-nine years. At the early age of seventeen he became the owner of the small Kromhout shipyard in Amsterdam, and when in 1894 the Netherland Shipbuilding Company was founded by a group of shipping and commercial interests, in order to revive the building of ocean-going ships in the port of Amsterdam, Mr. Goedkoop was invited to become the first managing director of the new company. Under his successful management the new undertaking grew from a very small yard, employing about a score of workmen, to an important shipbuilding yard with an international reputation. In 1919, when the company celebrated its twenty-five years of progress, Mr. Goedkoop retired and his two sons were appointed the joint managing directors of the company.

ELECTRO-HYDRAULIC SURFACE GRINDING MACHINE

THE LUMSDEN MACHINE COMPANY, LTD., GATESHEAD, ENGINEERS



An Electro-Hydraulic Surface Grinding Machine.

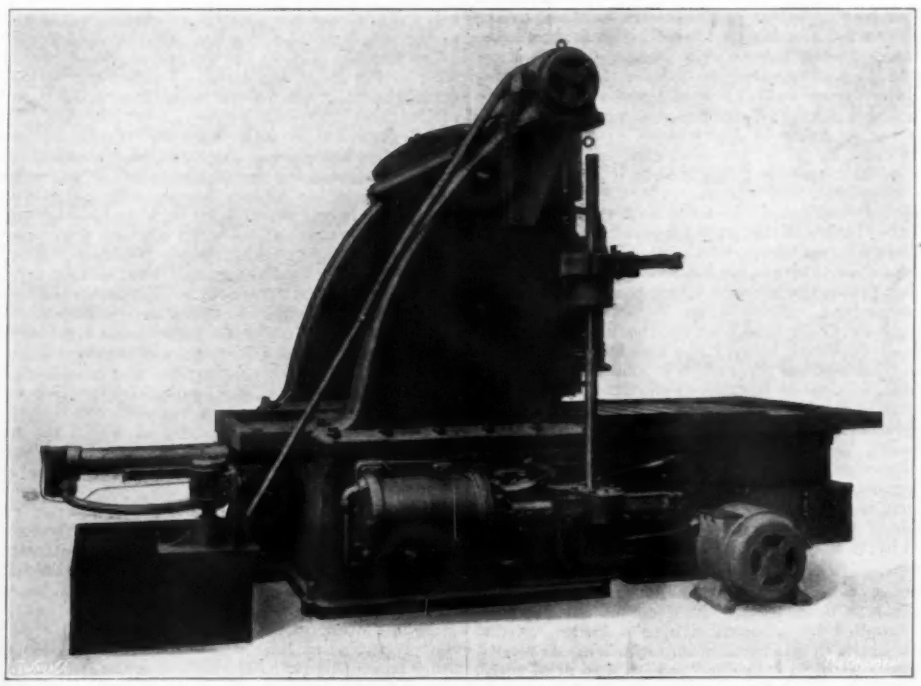
MODERN tendencies in the application of hydraulic power for the operation of machine tools are well exemplified in the design of the surface grinding machine illustrated herewith. This machine, made by the Lumsden Machine Company, Ltd., of Gateshead, for whom Alfred Herbert, Ltd., of Coventry, are the sole agents, is of the planer type. In addition, however, to the reciprocating table it is fitted with a transverse movement at the grinding head. The work can, therefore, be moved longitudinally beneath the grinding wheel or the grinding wheel can be moved transversely across the work, or both these movements can be applied simultaneously.

The longitudinal movement of the table and the transverse movement of the grinding head are effected hydraulically by means of low-pressure oil cylinders and pistons, supplied with oil from a rotary pump driven by a 6 horse-power motor. The transverse motion, as will be gathered from our second engraving, is communicated to the grinding head by means of a pair of racks and a vertical shaft carrying two pinions. The table can be set to travel a maximum distance of 94in., while the maximum cross traverse of the grinding head is 32in. With a segmental wheel 18in. in diameter these figures imply that the wheel can be caused to cover an area measuring 112in. by 50in. In practice, however, the wheel is usually allowed to clear the work in both directions. The capacity of the machine is, therefore, given on a conservative basis as 84in. by 30in.

The longitudinal and transverse movements of the work relatively to the wheel or of the wheel relatively to the work can, as stated, be applied separately or combined. Various methods of combining the two movements are possible. If, for instance, a hollow rectangular face has to be ground, the table travel and the head traverse can be set to come into action alternately, so as to cause the wheel to move uninterruptedly round the whole of the face. In a second arrangement the wheel can be moved automatically in the transverse direction at each reversal of the longitudinal movement of the table. The amount of the transverse movement at each reversal can be varied through a wide range. The movement, too, can either be uniform or can be varied as desired in jumps of 1in., 2in., 4in., 8in., or 16in. It is also possible to make the amount of the transverse jumps follow a given order. For example, at four successive reversals the jumps may be uniform, say, of 1in. each. At the fifth reversal the jump may be, say, 8in., to be followed by four more uniform jumps of 1in. This arrangement, it is claimed, is very useful when work with irregularly spaced faces is being ground. When any of these compound movements are in use, the transverse motion of the head does not begin until the table has stopped, while the table motion always waits for the transverse motion to be fully completed before starting off.

Automatic down feed of the wheel is applied at each reversal of the table motion or the grinding head traverse when these motions are in use separately. When the longitudinal movement is combined with a transverse movement at each reversal, automatic down feed is applied to the wheel at the completion of the total cross movement. If the movements are set to operate alternately, as when a hollow rectangular face has to be ground, the automatic down feed is applied either when the wheel returns to its starting point or at diagonally opposite corners of its path.

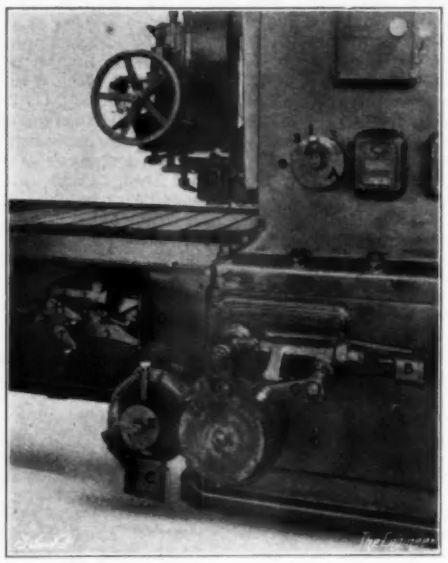
The bed of the machine is formed with one flat and one vee guide for the table and has bolted to it two heavy columns with guides for a cross saddle. The cross saddle can be raised or lowered on the columns by power, and carries a slide on which the wheel head is mounted. The wheel head is adjustable through a small range in each direction on the slide. It contains a cylindrical ram, which provides the vertical down feed and which carries in ball and roller bearings a flanged spindle. At the lower end of this flanged spindle the segmental grinding wheel is fixed. To the upper end the main driving motor of 30 horse-power is connected through a flexible coupling. The power elevation of the saddle, &c., is derived from a 4 horse-power motor mounted at the top of the left-hand column, as shown in our first engraving. The grinding wheel spindle is fully counterbalanced.



SIDE VIEW SHOWING LOW-PRESSURE OIL CYLINDERS

All the drives to the different parts of the machine are, it will be gathered, effected directly without the use of belts. Ball and roller bearings are fitted to all the shafts, including the feed and valve gear shafts. The lubrication of the machine has been closely attended to. Many of the parts run in and are lubricated by the oil used for the power transmission. The supply of water to the grinding wheel is derived from a motor-driven pump in conjunction with a settling tank.

The control system of the machine is illustrated in our third engraving. The switch shown at A has three positions which give respectively instant selection of table travel only, cross travel only, and compound movements. The



CONTROL SYSTEM

starting and stopping of these motions are controlled from the lever J. At E is shown a set of disc cams which are employed to give the various required jumps to the cross traverse motion. The disc F is graduated and carries two adjustable tappets, the positions of which determine the points of reversal of the cross traverse. A handle G is provided, whereby the cross traverse may be reversed manually if desired. The downward feed of the grinding wheel at the reversals of the cross traverse is controlled by means of a solenoid, which is energised by the action of a push button B. The table reversing gear operates triple push buttons D, which control the feed solenoid, a solenoid governing a diversion valve in the hydraulic circuit, and a third solenoid which controls a lock on the grinding head. Manual reversing of the table can be applied through the handle H. Finally, two push buttons C operate in conjunction with the jump discs. These buttons actuate the diversion valve solenoid, and the clamp solenoid.

A MACHINE capable of packing 85,000 to 95,000 cigarettes an hour, a greater capacity than that of any machine now in use, has been placed on the market by an American company. The machine counts the cigarettes, manufactures the package, affixes the Internal Revenue stamp, and marks packages containing defective cigarettes.

The New Heavy Engineering Shops at Kilmarnock.

ON Friday, June 7th, in company with a large number of engineers, we accepted the invitation of Glenfield and Kennedy, Ltd., of Kilmarnock, to be present on the occasion of the formal opening of the firm's new heavy engineering shops. Much regret was felt at the unavoidable absence, through illness, of Mr. James A. Morris, F.R.I.B.A., the chairman of the company, who was one of the directors of the original Glenfield company, which began business in 1865, and later amalgamated with the

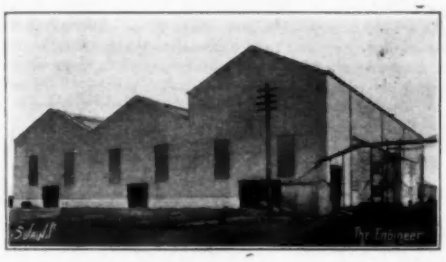


FIG. 1—END VIEW OF NEW SHOPS

Kennedy Meter Company. The new machinery was set in motion by Sir Alexander Walker, K.B.E., a member of the present board of directors, and Mr. E. Bruce Ball, the managing director of the company, outlined the purpose for which the new shops had been built, and gave some particulars of the equipment. During the day we spent at the works, both the new and old engineering shops, and the light and heavy foundries were inspected, and some interesting work was seen going through the various departments.

THE NEW ENGINEERING SHOPS.

In view of the ever-increasing size of hydraulic plant and the very large dimensions of the component units, the firm decided in 1928 to build and equip new shops to relieve the pressure in the then existing general shops and avoid congestion by allowing the larger work to be done under more advantageous and economical conditions. The Glenfield and Kennedy works are divided by the river Irvine. On the west side of the river are the firm's administrative offices and the older shops, while to the east of the river the heavy and light foundries and dressing shops have been constructed. A site alongside the light foundry was chosen for the new shops, and it will allow the new building, as at present constructed, to be extended to four times its existing size.

The external appearance of the completed shops will be seen from Fig. 1, which is a view of the western end of the three bays, a section through them being given in Fig. 2. The upper view on page 656 shows the structural steel work before the roof and side coverings were put on, and the lower illustration gives a general interior view looking down No. 1 bay.

The foundations were begun in 1928, and by the end of that year the majority of the machine tools had been erected, enabling production to begin in the early part of this year. In passing, it may be of interest to record that when preparing the site, an old timbered mine shaft was discovered. It was 8ft. square, with a depth of about 200ft., and the timber work was found to be excellently preserved, although the shaft was filled with water. Before proceeding with the main foundations, a thick concrete raft was floated over the shaft.

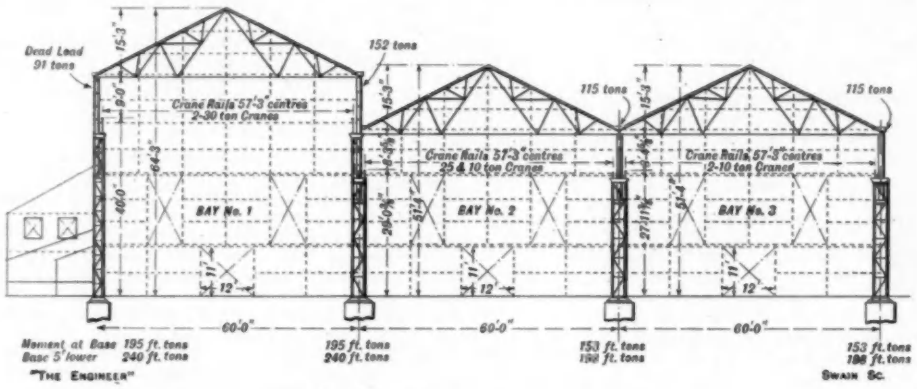


FIG. 2—CROSS SECTION OF NEW BUILDING

As will be seen from our illustrations, the new building is a steel-framed structure covered with galvanised iron sheets. There are three 60ft. bays, each with a length of 240ft., which is equally divided into eight sections. Provision has been made in the steel work for future additions to the present structure.

The main dimensions of the building are given in drawing, Fig. 2. It may be noted that in No. 1 bay there is at present a 30-ton Royce crane and the height from the floor to the top of the crane rails is 40ft. In No. 2 and No. 3 bays a 25-ton Chaplin crane and a 10-ton Marshall, Fleming crane are installed, and the height to the crane rails in these bays is about 25ft. The whole of the roof, with the exception of a narrow 5ft. strip at either end, is covered with Mellows' patented glazing. The artificial illumination is provided by a series of half-watt high-power lamps, arranged in the roof trusses. The building is painted in a light buff grey.

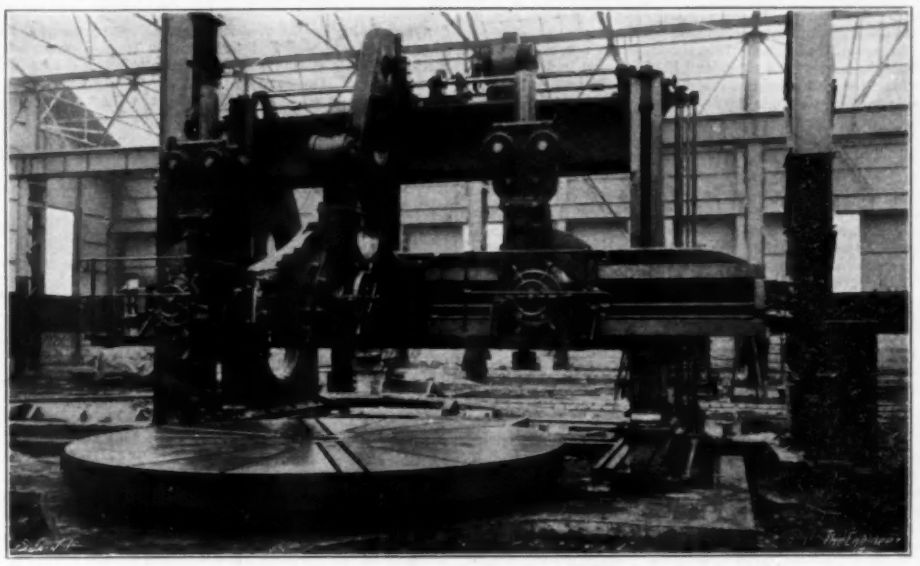
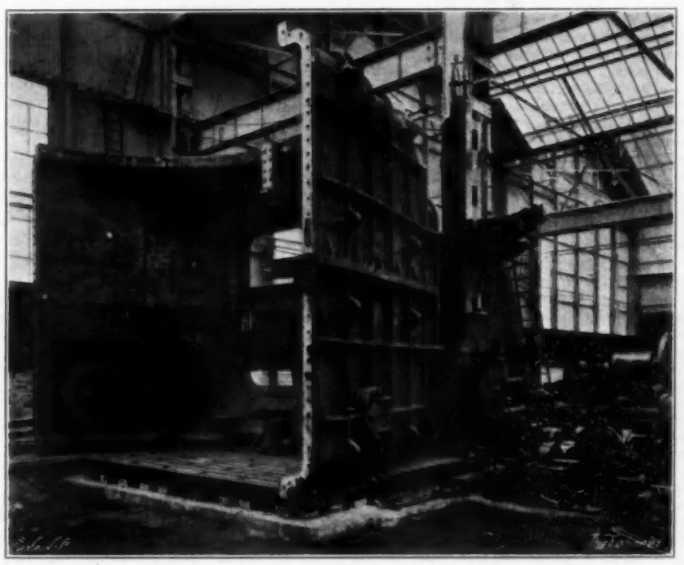


FIG. 5—25 FT. RICHARDS VERTICAL BORING AND TURNING MILL

The raw material for a given job can be delivered or dispatched either by road or rail transport. As shown in Fig. 1, there are sliding double doors, each 12ft. high and 11ft. wide at the west end of the building, with a similar arrangement of doors at the east end, and with suitable entrances and parking grounds for motor traffic. Within the building itself there are two full gauge railway tracks, connected with the firm's sidings, serving all three spans at either end. The raw materials are delivered at the western end of the shops and the different parts progress through the machine shops to the erecting floors at the far end. Various types of flooring were considered, and it was finally decided to use hardwood blocks laid in pitch on 6in. concrete. At the centre of each main bay there is a permanent pipe trench, in which all service pipes, such as hydraulic pressure mains for testing, river water for testing, town water, gas and electricity mains are accommodated.

An interesting feature in the new building is the arrangement adopted for the collection of metal turnings and shop refuse. Three portable steel containers of large size are sunk in concrete-lined pits, covered with steel gratings. The different containers are labelled "Cast Iron," "Steel Cuttings," and "Shop Refuse" respectively, and the waste material is collected by hand and tipped through the grating into the containers which, when full, are lifted by the overhead crane and transported directly to railway wagons or to the scrap heaps.

The new shops are warmed by eighteen "Stanlock" standard heating units, each of which has a designed output of 200,000 B.Th.U. per hour, when working under a steam pressure of 80 lb. per square inch. The warm air is drawn in at the top end of the unit, and is blown down on to the floor by a ¾ B.H.P. motor-driven fan. In summer the units can be utilised equally well to circulate cool air. Glenfield hygienic drinking fountains of the latest type are fitted here and there in all the bays. This fountain



FIGS. 3 AND 4—TURNING AND PLANING LARGE CONDENSER SHELLS

has an inclined jet, permitting the surplus water to fall clear of the issuing jet, the supply being controlled by a self-closing non-concussive valve. Although it has been specially designed for India, it possesses considerable advantages over the older designs, and is suitable for this country. To the right of Fig. 1 there will be seen three small annexes which are equipped as administration offices, stores and lavatories.

The supply of power for the electric motors driving tools only aggregates some 480 B.H.P., and is taken from the high-tension mains of the Ayrshire Electricity Board's supply system through the firm's own sub-station.

Machine Tool Equipment.

The machine tools in the new shop are all of modern design, and some of them are of very large capacity. On the occasion of our visit, many of the largest tools were at work on parts of the two condensers for the new Kirkstall power station at Leeds. We shall refer later to the special design adopted for these very large units.

In Fig. 5 we illustrate a 25ft. vertical type boring and turning mill, supplied by George Richards and Co., Ltd., of Broadheath, near Manchester. The machine has been specially built to withstand heavy cutting, and, as shown in Fig. 3, it will take castings with a diameter of nearly 26ft. The condenser shell shown in Fig. 3 necessitated a swing of 24ft. 6in., and the machine is thus shown working at almost its full capacity. The maximum depth under the cross slide is 9ft., and the depth under the tool holders 8ft. Other features include a new design of spring balance columns, and an enclosed type of swivel slide. The main drive is effected by a 50 B.H.P. motor, and for traversing two other motors, each of 10 B.H.P., are provided. Push-button contactor type controls are fitted, so that the machine can be stopped or started from more than one position. The whole machine weighs close upon 105 tons. There is also a smaller Richards boring mill.

At the top corner of No. 1 bay there is installed the 16ft. by 14ft. Shanks vertical and horizontal planing machine shown in Fig. 4. This machine, as illustrated, is also working on a section of the Kirkstall condenser. The planer is driven by a 30 B.H.P. motor, and is equipped with high-speed reversing gear, giving the following cutting and return speeds :—when planing a speed range of 15·3ft. to 61ft. per minute for cutting and 61ft. to 92ft. for return ; when slotting a speed range of 12·8ft. to 51ft. for cutting and 51ft. to 76·7ft. return.

Alongside this machine we noted a 7ft. by 6ft. by 26ft. Stirk Hiloplane, which was employed in machining the top faces of six large sluice valves at one setting. The gears of this machine are designed to give either a high or a low range of speeds, which are variable between 100ft. and 25ft. and 50ft. and 12½ft. per minute when cutting, with return speeds up to 200ft. This particular machine and several others were, we noted, equipped with the Lancashire Dynamo Company's patented planer drive. The large lathes include a 32½in. centre break lathe, by G. and A. Harvey, Ltd., with a capacity of 9ft. in the gap and capable of accommodating work 25ft. between centres. Its 26ft. bed is supported throughout its length by a bolted-down bed-plate, and is of massive construction. The headstock is totally enclosed, and the lathe is driven by a three-to-one variable-speed motor of 34 B.H.P., the maximum speed being 1470 r.p.m. We also noted other Harvey lathes, one of which is provided with an extension so that it can accommodate work measuring 35ft. between centres. Other large machines include a Kearns surfacing, boring, milling, drilling and tapping machine, which is designed to face work up to 40in. in diameter, and several high-speed drilling, studding and tapping machines of Asquith and Tullis designs, which were demonstrated in operation. In the No. 2 and No. 3 bays there are a large number of machine tools of smaller capacity which enable such operations as turning, slotting, shaping, screwing and grinding to be carried out within the shops. The finished and assembled material gradually passes down to the erecting floors at the western end of the shops. A special testing machine, which will take work up to 6ft. diameter, with a length of 36ft., has been installed, which, working with a hydraulic intensifier at 750 lb. per square inch on the low-pressure side, makes test pressures ranging from 750 lb. to 9000 lb. per square inch available.

At the time of our visit one of the two large vertical surface condensers for the Kirkstall power station, Leeds, was occupying the end of the large bay. As our illustrations show, these condensers are built up in three cast iron flanged sections, comprising a bottom water-box, the centre portion, and the top water-box. The total height of each condenser is 34ft. 2½in., with an internal diameter of 19ft. 4in. The whole structure is internally braced with vertical and transverse members. The design of the condenser is somewhat special to meet the unusual operating requirements. In the circulating water which will be employed there is a large quantity of fine woollen combings, which would rapidly choke up ordinary tubes. In order to prevent such choking, a single-flow design, with means for reversing the direction of the circulating water flow, has been adopted. The tube plates are also covered by guard plates, with holes so rounded out that no material can hang on the edges. In addition to the guard plates and tube plates, which are made of brass, there are two intermediate mild steel supporting plates, 18ft. 7½in. in diameter, each of which is made in four sections. We inspected some of these plates going through the shops, and others assembled in place in the condenser. Within the lower part of the condenser are special cast iron cross girders to support the tube plates, and these are also secured between the circumferential ends of the body castings. The tubes are expanded into the top tube plate and secured by screwed ferrules and packing on the bottom tube plate. There are altogether 10,000 1in. diameter tubes in each condenser, with a length of 16ft. The cooling surface of each of these large condensers is 46,000 square feet and the total weight of each unit is over 170 tons. These condensers are being constructed to the order of W. H. Allen, Sons and Co., Ltd., Bedford, which firm is responsible for the complete condensing plant and the heat balance of the new station.

In other parts of the works we inspected specimens of the firm's new type of Glenfield drop tight tilting disc valves, which are being made in both small and large sizes. In the firm's hydraulic testing laboratory, some interesting comparisons were being made between the loss of head attained in such a valve, compared with other types of reflux valves; a new type of air freezing valve was also demonstrated. The "Peebles" patented washer for filter bed sand was also shown in operation, and numerous instruments for water level readings and winding speed analysis along with other apparatus were on view.

There is no doubt that the new shops of Glenfield and Kennedy, Ltd., will enable that firm to undertake economically the largest class of hydraulic engineering work. The whole of the constructional and equipment work for the new shops was carried out by the firm under Mr. E. Bruce Ball's direction, and with the assistance of Mr. Henry Gardner, works manager, Mr. R. Robertson, clerk of works, and Mr. A. Russell, the machine tool superintendent.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

WHIRLING SPEEDS OF LIGHT SHAFTS CARRYING SINGLE CONCENTRATED LOADS.

Sir,—It has frequently been stated that a light shaft carrying a single concentrated load will run steadier at speeds above the whirling speed. This statement then means :—

(1) That a light shaft carrying a single concentrated load can only have one whirling speed ; and

(2) That the shaft, together with the load, will run steadier at speeds above the whirling speed.

The above deductions are usually arrived at as follows :—

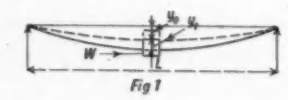


Fig 1

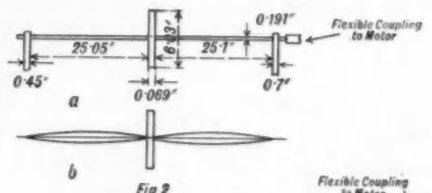


Fig 2

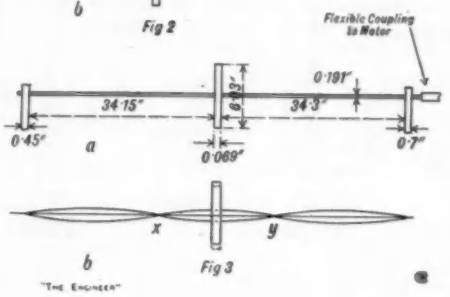


Fig 3

"The Engineer"

Referring to Fig. 1—the load being assumed at the centre of a light shaft—let

y_0 = the initial deflection, *i.e.*, the deflection when the shaft is stationary.

y_1 = the deflection caused by the centrifugal forces.

Then $y_0 + y_1 = y$ (say) the total deflection.

Equating the controlling force to the centrifugal force then

$$\frac{48\,E\,I}{L^3}(y - y_0) = \frac{w}{g}\omega^2 y,$$

where E = modulus of elasticity,
I = moment of inertia of the shaft,
ω = angular velocity.

$$\therefore y = \frac{y_0}{1 - \dfrac{w\,\omega^2\,L^3}{48\,E\,I\,g}}$$

and when $1 - \dfrac{w\,\omega^2\,L^3}{48\,E\,I\,g} = 0$, then y is infinite and whirling occurs, and therefore when whirling occurs $\dfrac{w\,\omega^2\,L^3}{48\,E\,I\,g} = 1$, and this gives only one positive value for the whirling speed.

When the speed is increased beyond the whirling speed $1 - \dfrac{w\,\omega^2\,L^3}{48\,E\,I\,g}$ gives a negative quantity and therefore y is negative, and this means that the shaft is straightening and the shaft will therefore run steadier at speeds above the whirling speed.

It was thought that the deductions (1) and (2) required closer consideration, and for this purpose a few experiments on loaded light shafts were carried out.

A light shaft loaded with a disc at the centre was supported in plain bearings and was driven by a variable-speed motor through a flexible coupling—see Fig. 2 (*a*) for dimensions and load. At about 100 revolutions per minute the shaft with the disc whirled in a single bow ; this speed could only be obtained approximately because the control of the motor at low speeds was not very good. On increasing the speed the shaft and disc ran steadily up to 1520 revolutions per minute, when it was observed that the shaft on each side of the disc whirled and that the disc ran steadily—see Fig. 2 (*b*).

If it is assumed that each portion of the shaft is supported at the disc and at the bearings then the usual expression for a parallel shaft, viz., $N = \dfrac{4{,}800{,}000\,d}{L^2}$ may be applied to each half of the shaft, then N = 1455 revolutions per minute, which agrees to within a small percentage of the observed speed. Also it may be observed that the lighter the shaft is made the lower will be this second whirling speed.

As the maximum speed of the motor was only 2100 revolutions per minute and the shaft ran steadily after this second whirling speed up to this speed, a longer shaft was employed with the object of obtaining a third whirling speed.

The object was obtained with three different loads. The results are given in the accompanying table, and for the dimensions of the shaft and disc used in experiment 3 see Fig. 3.

	Weight of disc.	First whirling speed.	Second whirling speed.	Third whirling speed.
	lb.	r.p.m.	r.p.m.	r.p.m.
Expt. 1 ..	0·197	80 (about)	800	1860
Expt. 2 ..	0·412	80 (about)	820	1740
Expt. 3 ..	0·687	70 (about)	820	1640

The shafts in each experiment took up a form as indicated by Fig. 3 (*b*) on the third whirling speed being reached, and it was observed that the heavier the loads the nearer the nodes *x* and *y*—Fig. 3 (*b*)—approached the disc.

It will be noticed that the second whirling speeds were about the same in all experiments, and they agree closely with the calculated speed of 780 revolutions per minute.

Whilst the third whirling speed is not attained in practice, there are, however, some high-speed rotors that approach the second whirling speed. It is submitted, then, that in designing high-speed rotors employing light shafts it is necessary to obtain the speeds at which the two portions of the shaft whirl.

The experiments were carried out in the Engineering Laboratories of Leeds University.

T. M. Naylor, M.Sc., A.M. Inst. C.E.

The University, Leeds, June 6th.

THE DECAY OF CRAFTSMANSHIP.

Sir,—A most interesting comment on the decay of craftsmanship appeared in The Engineer of May 3rd, 1929. It is said that none of the old aptitude for handicraftsmanship has been lost in this country. In every modern works and in many back street small engineering shops one may find a few men—generally in the tool-room—who still find pleasure and pride in the doing of their work, and here and there draughtsmen who feel a real delight in the production of well-finished drawings. We cannot progress without skilled men ; we still need real mechanics, clever with their hands as with their brains. Years ago the young engineer took his training at the bench and was taught how to use tools. Nowadays he is taught the use of tools—which is quite another thing. Skilled mechanics are now scarcer than ever in England, and little inducement is offered them to remain in this country, and the best of them go abroad, many to America, where they receive higher wages and more respect. The position is becoming more and more serious, and although the danger has been foreseen for some years, whatever effort has been made to retrieve the position, has been unavailing. Low wages are no doubt the primary cause, and there is a tendency to underestimate the need of skill.

Engineers of ripe experience will agree that the foregoing is too true, and we must ask ourselves as to what is the best course to pursue in order to foster and encourage the art of craftsmanship among the younger generation. In the course of thirty years' experience in the workshop side of engineering there appear to me to be fewer apprentices now than formerly, and a revival of the apprenticeship system in this country is suggested as some means towards raising craftsmanship to its proper importance. But no haphazard system will do. Too often a youth, after becoming bound by indentures, is allowed to drift along in the workshops at his own sweet will. If he happens to be observant and possess a true love of making and doing things well and an experienced workman takes a real interest in the youth's progress to help and teach him, then he has the makings of a good mechanic. There is no obligation on the part of the workman to teach anyone. He receives no compensation from the employer or the apprentice, from a money standpoint, not even a small percentage of the premium. The only compensation maybe is the satisfaction gained in the knowledge that a fellow creature has been helped along life's highway, and the possible love of boys. It may therefore be possible to offer the expert craftsman some inducement to superintend and guide the most likely lads in the shop in their training.

Much might be accomplished if employers took a greater interest in the large number of boys employed in workshops. Many of them commence their engineering career, not as indentured apprentices, but as errand boys, capstan or drilling machine operators, and many of them turn out to be smart machinists or machine setters after two or three years' experience. The earnings of these lads are generally greater than in 1914, even allowing for the higher cost of living, and through the lack of proper control they have more money to spend at cinemas and frivolous amusement than is good for them. Consequently the day's

work is entirely forgotten and it is seldom that one finds the engineering youth using any surplus pocket money in the purchase of books or any of the interesting journals published weekly, which contain many useful articles, hints and tips on everyday engineering workshop problems.

Here lies the chance of the employer, who might for a small financial consideration persuade one of the leading members of his staff to round up the promising youths in the workshop, on two or three evenings in a week, and to give lectures of an interesting character appertaining to their own daily work. Many of the boys would surely be fired with ambition or the desire to become first-class workmen if they were told of the early lives of some of our greatest engineers, and how by diligence and hard work success had been attained. In the absence of parental advice or guidance, the influence of employers after working hours may be of benefit to the youth, the employer, and the maintenance of engineering craftsmanship. It may be as well to suggest here the necessity of politeness, willingness and ever-readiness to do small services on the boys' part for the older and experienced men in the shops. It is well known that the latter will often avoid imparting useful workshop knowledge to any lads who appear impudent and disobliging. This is to be regretted, as most men are only too pleased to give a boy a helping hand when the need arises, and so it behoves boys generally not to lose any chance of learning for the sake of civility and respect. The writer has never lost an opportunity of teaching a lad who showed promise, and it would be a good thing for the trade if men of experience would more readily give assistance to the young engineer, especially where appreciation is evident. E. M. H. S.

June 10th.

GRAND JUNCTION RAILWAY LOCOMOTIVES.

SIR,—Authentic information, as requested, is as follows:

No. 65.	R. Stephenson and Co., 5ft. wheels, four-coupled.	"Charon."
66.	C. Tayleur and Co., ditto.	"Colossus."
67.	Ditto, ditto.	"Briaræus."
68.	Ditto, ditto.	"Antæus."
69.	R. Stephenson and Co., ditto.	"Python."
70.	J. Melling and Sons, ditto.	"Sphinx."
71.	R. Stephenson and Co., ditto.	"Typhon."
72.	Ditto, ditto.	"Phlegethon."
49.	Crewe Works, 6ft. wheels, single. February, 1845.	"Columbine."
73.	Ditto, ditto. 1845.	"Prince."
19.	Ditto, ditto. 1845.	"Princess."
74.	Ditto, ditto. 1845.	"Deva."
75.	Ditto, ditto. October, 1845.	"Apollo."
76.	Ditto, ditto. 1845.	"Albion."
77.	Ditto, ditto. 1845.	"Mersey."
78.	Ditto, 5ft. wheels, coupled. 1846.	"Lonsdale."
79.	Ditto, 6ft. wheels, single. 1846.	"Belted Will."
80.	Ditto, ditto. 1846.	"Dalemain."
81.	Ditto, 5ft. wheels coupled. 1846.	"Greystoke."
82.	Ditto, ditto. 1846.	"Wordsworth."
83.	Ditto, ditto. April, 1846.	"Windermere."
84.	Ditto, 6ft. wheels, single. 1846.	"Saddleback."
85.	Ditto, ditto. 1846.	"Ingestre."
86.	Ditto, ditto. 1846.	"Sandon."
87.	Ditto, 5ft. wheels, four-coupled. 1846.	"Eden."
88.	Ditto, ditto. 1846.	"Lune."
14.	Ditto, 6ft. single. 1846.	"Witch."
16.	Ditto, ditto. 1846.	"Lynx."
29.	Ditto, ditto. 1846.	"Alaric."
33.	Ditto, ditto. 1846.	"Erebus."
54.	Ditto, ditto. May, 1846.	"Medusa."

No 73 was afterwards changed to "Prince Albert" and No. 87 to "Earlestown."

Nos. 14, 16, 29, 33, and 54 were built in the first six months of 1846.

No. 49 was the first new engine built at Crewe; it was exhibited at Wembley in 1925 and is still in existence.

Nos. 67 and 72 were in collision at Whitmore early in February, 1841, so presumably they would be built in 1840.

It is regretted that only the months of build'ing of four of these engines is known to the writer.

W. LAIDLAW.

Manchester, June 10th.

INVENTION.

SIR,—The correspondence which has just developed in your columns in connection with the dissertation of Mr. Turnbull on invention rather intrigues me, for I remember two well-established sayings—"There is nothing new under the sun," and, on the other hand, "Always something new from Africa." The first spoils "The Boatman's" suggestion that inventions are inspired, as they must have been forestalled. The second saying, which, presumably, is equally justified, suggests that a country where methodical education has not been greatly developed produces the better part of novelties. Either one can be true, and, possibly, both; but I feel rather inclined to support the idea of "The Boatman" that teaching spoils inventive genius. The examples given in controversy by Mr. Turnbull do not carry much weight, as they are obviously stories of development, while Mr. Sharratt rather labours the Patent Office definition of an invention. Does he remember that practically every patent specification is headed with the term "Improvement"? True inventors are far and few between; they were moderately prolific about two generations ago; they are anathema to the modern manufacturer, but unless we have soon some ideas of outstanding merit, past progress cannot be continued.

Can you, Sir, or any of your readers, give any hope of "buds" developing under the culture suggested by Mr. Turnbull, while little effort or support is made towards the raising of completely new stock? A budding can be made by any reasonable craftsman, but the production of a new stock is seldom achieved, and then it is a matter of luck or genius.

Does not Mr. Turnbull confuse the difference between immediate invention and subsequent development?

A DISGRUNTLED INVENTOR.

Isleworth, June 15th.

THE PURIFICATION OF FLUE GASES.

SIR,—With reference to your article on this subject in the issue of June 7th, we would mention that in 1906 the boiler plant at a large cocoa works was being so heavily pressed that a good deal of grit was being discharged by the chimney from the flue gases. This was very objectionable to the management in their operations, and their engineer determined to make some experiments in washing the flue gases with water sprays.

He explained to us his ideas and we supplied some of our spraying nozzles to him for experimental purposes. His trials were satisfactory, and he got out designs and built a plant to deal with the whole of the flue gases from the battery of six full-sized Lancashire boilers. The results obtained were exceedingly good and quite got over the trouble with grit. Not only was all the grit removed, but also the smoke, and the sulphur acids—calcined as SO_2—were reduced from 0·2 grammes per cubic metre to 0·005. The grit collected amounted to about 1600 lb. (dry) per twenty-four hours, of which about 60 per cent. was combustible matter.

The minimum amount of water for efficient results was 7000 to 8000 gallons to deal with 2,400,000 cubic feet of hot gases per hour. The flue gases after leaving the economisers at about 320 deg. Fah. passed into a brick chamber or flue, in which they were made to pass up and down twice by baffles, and were then drawn out by an induced draught fan and discharged into a steel chimney at about 130 deg. Fah. The gases flowing through the chamber were met by water spray from the nozzles as they passed up and down between the baffles, and the water ran to waste at about 112 deg. Fah. into settling tanks.

At the August meeting of the British Association at York in 1906 a paper was read describing this flue gas washer by S. H. Davies, M.Sc., and F. G. Fryer, A.M.I. Mech. E. JOS. H. HARRISON AND SON.

Middlesbrough, June 11th.

"ROCKET II."

SIR,—In your delightful article of May 31st you have, I believe, sensed the feelings of all who have seen "Rocket II.," and particularly of those who witnessed its trials. It was a remarkable and moving occasion. One spectator counted it among the red-letter days of his life—including his wedding day. I forget which he put first.

But as one of the "head-waggers" and, shall I say, "midnight oilers," who have the honour of mention in your article, I am sorry not to find myself again in the company of A. H. Molyneux, chief draughtsman to the builders.

He had a more anxious and difficult task throughout than that of historians and model maker; and the qualities which give distinction to his work as a "modern" were invaluable in solving some of the problems of the historic past. There was also the enthusiastic help of H. Windale, and I shall be glad if you will grant me the opportunity to add his name also to your record.

I do not suppose that either of these gentlemen will thank me for this letter, but I only regret that circumstances have delayed the writing of it. J. G. H. WARREN.

Bath, June 11th.

THE STABILOGRAPH.

SIR,—In your most interesting article on May 3rd on the "Stabilograph," it was stated that experiments on a ferry boat showed the vessel trimming 0·5 deg. by the stern at full speed. I trust that the writer of the article satisfied himself that this was not due to the fact that, in this case, the line of thrust of the propeller passed beneath the centre of effort of the forces resisting progress. If this were the explanation, then trimming by the stern, when moving through the water, would not be a general characteristic of ships.

A. FINDLAY.

London, E.C. 2.

SIXTY YEARS AGO.

THE proposal for the abolition of the granting of patents for inventions and the substitution therefore of State rewards to deserving inventors, continued in our issue of June 11th, 1869, to attract our attention and excite our opposition. As we remarked in this note last week, there was a considerable volume of opinion then in existence which favoured the proposal, and there had recently been a lengthy debate in Parliament on the subject. One of the chief abolitionists was Sir William Armstrong. The conditions under which Sir William lent his support to the proposal were, however, according to our opinion, such as to render his views open to the charge of being biassed. He was a quasi-Government servant, and the sweeping away of all patent rights would have greatly facilitated his work. He was, we noted, in favour of the abolition of the granting of patents without reward or recompense to the inventor. Such a policy he held would not dam up the wells of invention, for the inventive mind could not cease its functions, and inventions would continue to be made, patents or no patents. We described his proposal as a piece of outspoken cruelty. Nevertheless there were many, we thought, who would prefer Sir William's plan to that advanced with bland suavity by Mr. Macfie, the Liverpool sugar refiner, and of others who supported him, which covered abolition coupled with the granting of State rewards. Was a tribunal of the Board of Trade to sit in judgment to decide the value of an embryonic invention and to assess the reward which the inventor should receive for it? The value of many an invention, we contended, was not evident on its inception, or indeed until long years of patient trial had gone by. Was the reward, if granted, to be drawn from the Consolidated Fund? If so, we held, the taxpayer would have strong grounds for resenting the liability that would be thrust upon him. To illustrate our argument we recalled the history of the vacuum pan and the patented process of boiling sugar in vacuo. The inventor of the vacuum pan, the Honourable Mr. Howard, would, we held, have found his idea dismissed by a Board of Trade committee as being of no practical value at all. That committee would have been compelled to rely on the testimony of practical sugar refiners and, as was well known, the old race of sugar boilers, encouraged by the early shortcomings of the vacuum pan, were opposed to vacuum boiling. In the end, after the invention had been improved, sugar manufacturers were glad to employ the vacuum pan and to pay a royalty of 20s. a ton on the sugar evaporated in it. For many years the Howard patents yielded the inventor a princely revenue of half a million pounds sterling per annum. The case was, we admitted, an extreme one, but the large number of less remunerative inventions which would fall to be rewarded would, we argued, throw an unendurable burden on the national exchequer. It was evident that any system of State rewards could not go beyond the granting of small gratuities, and would not afford any equivalent of the remuneration frequently secured by patentees for themselves under the operation of the existing patent laws.

South African Engineering Notes.

National Road Policy.

THE Union Government, owing to the development of road transport, is now faced with the necessity of regarding the question as one of national importance. In South Africa, as in other parts of the world, roads first opened up and developed the commercial resources of the new territory, and they continued to do so until rail transport was introduced and soon became the greater system. Then roads seemed to fall into relative disuse. But road vehicles have been developed, and the roads are once again resuming their old importance. In a country like South Africa, with a small scattered population, with towns far apart, the demand for systematised road communications is becoming greater almost daily. Though railways must continue for many years to be the medium for heavy transport gradually, owing to the wider use of road motor vehicles, passenger and goods traffic is passing from the rail to the road. It is widely held that the day is not far distant when the Government of the country will have to consider the creation of a Ministry of Transport. The limitation of branch railways has already been adopted by the Government, mainly owing to the development of road transport services, and the Government has also appointed a Commission recently to investigate the competition of road motors with the railways. The adoption of a national policy will include the construction and maintenance of roads, the regulation of road vehicles, and their legitimate taxation, and the formulation of a consistent policy of transportation in general. Last session the Government provided one million sterling, which is to be divided among the Provincial Councils of the four Provinces of the Union, and used for road construction. More will be done in the same direction, no doubt, after the Commission has reported and a national policy has been decided upon.

Bridges play a great part in road communications, and in that respect the Union has done a good deal during the eighteen years which have elapsed since it was brought into being. During that period 351 bridges have been built at a cost of £1,700,000. At the end of the 1928 financial year there were twenty-six bridges under construction at an authorised cost of £117,169. This heavy expenditure is principally due to several inter-provincial bridges over the Vaal River. The most notable bridge under construction in South Africa at the moment is that which is being erected at Liebigs Drift on the Limpopo River which there divides Rhodesia from the Union. It will be known as the Alfred Beit Memorial Bridge, as its cost is being defrayed by the Beit Trustees. This bridging of the Limpopo will be of the greatest assistance to motoring in South Africa. When it is completed it will be possible to journey to and from Rhodesia all the year round instead of only at times when the flow of water in the river is small.

Blast-furnace Shut Down.

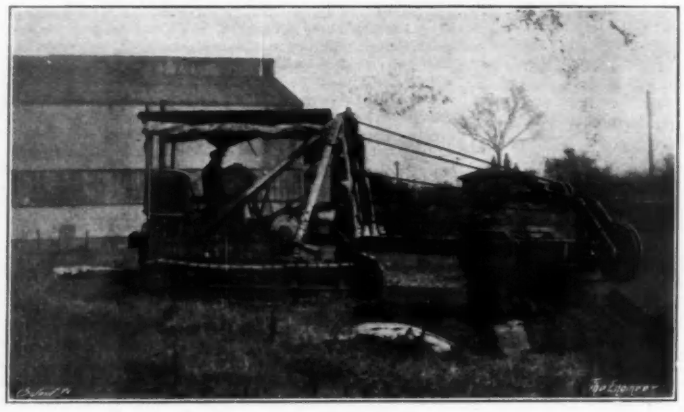
For the second time, the blast-furnace of the Union Iron and Steel Corporation at Newcastle, Natal, has been blown out. It has been necessary to take this step owing to overproduction of pig iron. After working six months on this occasion the company has in stock approximately £100,000 worth of pig iron for which there is no market. During the six months 28,000 tons of pig iron were produced, so that it has been proved that the plant is capable of producing the amount required to obtain the Government bounty of £1 10s. per ton, namely, 50,000 tons per annum. The State-aided plant, which is to be established at Pretoria is to have a capacity of 150,000 tons of pig iron per annum. The two works will, therefore, be able to produce 200,000 tons and more per annum, and the question is, How will it be disposed of?

MULTIPLE-PURPOSE EXCAVATING MACHINE

DENHOLM, CONTRACTORS MACHINERY COMPANY, LTD., LONDON, ENGINEERS

ACTUATING MECHANISM, SHOWING FAIR LEAD FOR DRAG LINE

FULL TRENCHER BUCKET EMERGING FROM TRENCH

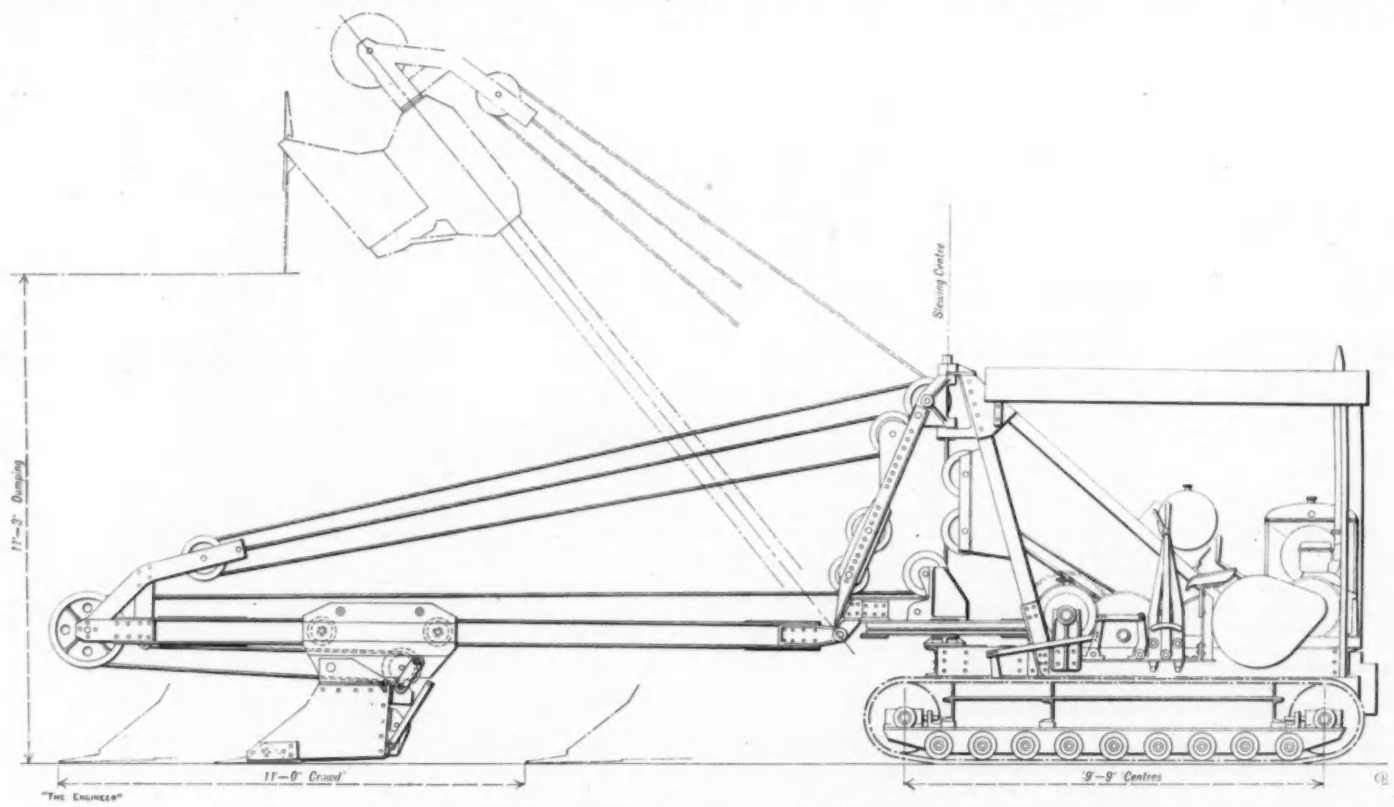


HALF-CUBIC-YARD SKIMMER BUCKET TAKING CUT

BOOM FITTED WITH SCRAPER FOR BACK-FILLING TRENCHES

An Adaptable Excavating Machine.

ON a recent occasion—it was just when the hard frost of the winter turned to a sudden thaw—we had the opportunity of studying a new excavating machine at work. It was the ½ cubic yard machine represented in the accompanying half-tone engravings and drawing. It was made by Denholm Contractors Machinery Company, Ltd., of Astor House, Aldwych, London, W.C. 2, and the conditions under which it was working were distinctly arduous. The surface of the clayey soil was slippery and soft, but a few inches down the ground was frozen to a depth of about a foot and a-half. In these conditions, the machine, rigged as a trench excavator, dug down to a depth of about 10ft. and only once during an afternoon's trial when the driver was, perhaps, trying to "show off" too much, did the dipper fail to pull through with a full cut. Even then it was a simple matter to obtain a release and get the dipper, full, out of the trench.



THE MACHINE ADAPTED TO OPERATE AS A SKIMMER

The machine is of the half-swing type; that is to say, the jib can be rotated through an angle of 180 deg. on a relatively stationary frame. The whole machine is mounted on caterpillar tracks, and is driven by a 40 horse-power petrol engine.

In evolving the design an effort has been made to provide an appliance which is adaptable to several of the classes of work carried on by contractors, and although we did not have an opportunity of studying it at work in the whole of its different guises, we can quite understand the statement that it will serve as a simple crane, as a grab, as a ditcher, as a drag line, and as a skimmer.

The essential feature is the provision of two winding drums, either or both of which can be driven by the engine through an appropriate train of gearing. These drums are used to manipulate two wire ropes, which effect all the useful operations of the machine. In the case, however, of the drag line arrangement, another rope is added for the

luffing of the jib, and this rope is worked by means of a hand winch, as it is so seldom necessary to alter the angle of the jib that a power drive is not justified.

On reference to the drawing, which represents the machine rigged as a skimmer, it will be seen that the two ropes from the two winding drums pass over fairlead sheaves arranged at the axis of rotation of the jib in such a manner that any angular movement of the jib is accommodated by a torque in the rope. One of the ropes is used for luffing the jib and the other for manipulating the skimmer bucket. When the machine is required for trenching, a special bucket, on a short lever, is attached at the end of the jib, as is shown in one of the engravings. Then one rope is rove round a pulley at the head of the lever, and is used for derricking purposes, while the other rope is attached to a traveller on the jib, which is connected to the bucket by chains, and is used for the actual digging operation. The rigging for crane work and for drag-line excavation hardly needs description.

The one engine has to serve four distinct functions in either direction—driving the two winch drums, swinging the jib and propelling the whole machine. All these operations are, however, performed by a comparatively simple train of gearing, which is largely of the bevel type. A peculiarity of the arrangement is that a free-wheel device is arranged between the winch barrels and their brake drums, and that the brakes are normally held on by springs. The result is that the rope can always be wound in with the free-wheel running loose, but as soon as winding is stopped the free-wheel jams and the brake holds the load without any effort on the part of the driver. He can, however, lower the load by releasing the brake, when the winch barrel and brake drum revolve backwards as one piece. The manipulation of the clutch for the drive to each barrel and of the brake for lowering away is effected by one lever, and there are no foot pedals, so that the driver can sit or stand at his work in comfort.

Slewing the jib is effected by a rope wrapped round a large bull wheel, and is operated by two gear-driven drums. The normal rate of slewing is as much as 5 revolutions per minute, and we have timed a half revolution swing with a full bucket in slightly less than six seconds.

There is only one other mechanism which needs description, and that is the drive to the caterpillar tracks. This is effected by two shafts, connected together by a differential gear, with which the engine is connected. On each shaft there is also a brake drum and band. By applying either of these brakes, the track on that side is held stationary, while the other track, freed from the braking effect, is driven, either forward or backward, by the engine. In this way the machine can be steered round quite small circles. The tracks are of such dimensions that the bearing pressure on the ground is only 6¼ lb. per square inch. They are 9ft. 9in. long between centres.

The total weight of the machine is about 10 tons, and it measures 12ft. long by 8ft. wide by 9ft. 6in. high. As a trencher it will dig to a depth of 16ft., and, for drag line work, it will carry a boom 30ft. long.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

CONDITIONS in the iron and steel and engineering industries of the Midlands and Staffordshire show no material change on the week. All eyes are turned on the new Government, and there is a growing feeling that with wise handling of the situation, the trade development which has made itself evident this year need not be interfered with. Industrialists, since they learned the constitution of the new Cabinet, have been less concerned than they were for the future of the heavy industries of the country, and many are now taking stock of the economic factors in the various branches in preparation for the anticipated release of pent-up business. The weekly meeting of the Midland iron trade in Birmingham was well attended, and though business was not what one could truly describe as brisk, it was not sluggish, and the market tone was bright and hopeful.

Pig Iron Purchases.

Opinions as to the effect of the increase in pig iron prices vary. On one hand it is held that buying has been stimulated and that smelters are experiencing some little difficulty in keeping abreast of orders, while, on the other, it is equally positively asserted that the shilling advance has not been followed by any rush of buying, and that demand is as quiet as it was before the appreciation of prices. What is certain is that there is no great surplus of iron, and that values are firmly held at the level fixed by agreement amongst the makers. While supply and demand are in equilibrium smelters are likely to maintain the price level. Whether equilibrium can be maintained till consumers have used up their reserves and are forced to buy on the terms laid down by the seller, is the question now under discussion. Black Country foundrymen's requirements are not increasing as was expected. There has been more activity at the forges in recent months than for a long time previously, but this is nothing like so important a factor as it was twenty years ago. Contracts are gradually running out, and for the most part are not being renewed, consumers being content to buy on the open market just sufficient material to cover current needs. Some foundrymen, however, who are better off than the majority, have made new commitments at higher rates. Merchants, who report business as very quiet, are disappointed that they are not getting more orders for pig iron. It appears that this trade is being done increasingly direct from the furnaces to the consumer. Should any expansion of business with the merchants take place they will find themselves more advantageously placed as a result of the new basis of commission now agreed upon.

Finished Iron.

In the Staffordshire finished iron trade the marked bar mills are still doing a steady business at £12 per ton, and the prospects of regular work are considered satisfactory. Activity is not so even in Crown bars, but competition is less severe. Underselling has abated somewhat, as mills have got more employment. Forgemen complain that though they are less heavily handicapped in the ratio of overhead expenses, the profit margin is very meagre by reason of the increased cost of pig iron. They are therefore endeavouring to get better prices for their products. It is asserted by some Staffordshire ironmasters that it is not possible to buy Crown iron below £10 per ton. Until recently quotations have ranged from about £9 10s. to £10, works keeping their prices as low as possible in order to compete with ironmaking districts nearer the coast. The increase in pig iron costs has changed the circumstances, and makers think they should now get at least £10 per ton for their output. Some producers are asking half-a-crown above this latter figure, but it is impossible to trace business as having been done at this price. Demand for native nut and bolt bars remains dull, and it is questionable whether £9 represents the lowest levels acceptable to producers. Belgian No. 3 iron at £7 2s. 6d. sells freely. Wrought iron tube strip commands £10 17s. 6d. The Black Country tube trade, despite keen competition both at home and from the Continent, is fairly good, there being a better demand from the shipyards. Demand for strip, both iron and steel, consequently remains good.

Steel.

Demand for finished steel is poor. Midland constructional engineers are handling small business calling for relatively poor tonnages of steel. The steel works, thanks in part to the call for special steels for the automobile industry, have moderately good order books, and employment at the mills is fairly regular. Angles and joists are unchanged in price, being quoted £8 2s. 6d., less rebate to users of British steel exclusively. Ship, bridge and tank plates, for which there is an improved call, are £8 17s. 6d., and boiler plates £9 15s. Staffordshire steel hoops sell at £10 per ton. Re-rollers of small steel bars keep up their quotations, £8 7s. 6d. upwards being generally asked. Some diversion of business in favour of the foreigner, who is offering supplies at relatively low prices, is spoken of. The demand for semis continues to quicken. Prices asked for foreign billets and sheet bars are so high that British makers are able to sell their output at enhanced rates. Quotations for Welsh billets this week were £6 10s., and the English mills wanted £6 12s. 6d. Some English makers have done so well since the rise in the continental market that they are quoting fancy prices several shillings above the average of £6 12s. 6d. German shippers quote f.o.b. prices, which work out at about £6 6s. delivered here in the case of 2in. billets, and £6 1s. 6d. for 2½in. to 4in. Imported sheet bars are £6 3s. 6d. Continental buying keeps on the quiet side, although there is always a certain amount of foreign products coming in regularly to Black Country works, either for finishing or re-sale. This includes Belgian bars, both iron and steel and steel strip.

Galvanised Sheets.

Galvanised sheets continue at £13 12s. 6d. basis. Mills are making a good output, but the lull in inquiries and new business is such as to cause makers some anxiety. Regular activity at the mills in the future depends upon some enlivenment of the export markets, nothing of any magnitude being expected from home sources in the immediate future. Makers are of opinion that a lowering of prices would not result in a reinvigoration of demand sufficient to justify such action. Consumptive demand they say at the moment is small, but it will increase before long.

Scrap.

Pressure for heavy steel scrap has relaxed. Prices are on last week's level of £3 15s. to £3 17s. 6d. delivered in South Wales with an increasing proportion of business being done at the lower figure. Demand remains good.

Trade Revival Prophecy.

Mr. John H. Crabtree, in a recent address in Birmingham, ventured on a prophecy as to a trade revival. Giving the sum of the deductions he had arrived at after a methodical study of trade cycles since the Napoleonic era, he showed how the price of gold was closely connected with the ups and downs of trade, and said we had to face the fact that we should probably only get one good year of trade for two and a-half bad years. With the general trend of falling prices in Europe, booms in industry could not be expected for more than one year in three. The end of next year and the following year would be the period when the trade of this country would show an appreciable revival from the slump into which it had fallen since 1920–1921. Mr. Crabtree spoke of the growing use of business forecasting, and market research in the control of present-day business and manufacture. Increased interest in the subject had been brought about, he said, by the boom and the subsequent slump after the war. Unless the large number of small industries in the country paid attention to business forecasting and economics, there was a grave danger that some of them would be eliminated in the coming phase of "big business."

Rolling Stock Contracts.

Midland rolling stock firms have added to their order books some really good contracts of late. The Metropolitan-Cammell Carriage Wagon and Finance Company of Birmingham has received contracts for twenty-five bogie tank wagons for the Union of South Africa Railways, for ten all-steel bogie coaches for the Cordoba Central Railway, and for 294 light-type bogie frames and thirty-three heavy-type bogie frames required for passenger rolling stock of the London and North-Eastern Railway. The company has also secured from the Crown Agents for the Colonies orders for seventy-five goods wagons and two vans for the carriage of motor cars for use on the Tanganyika Railway, and eleven brake-van underframes for the Kenya and Uganda Railways. The Gloucester Railway Carriage and Wagon Company has received a contract for six bogie carriages for the Entre Rios Railway, while the Birmingham Railway Carriage and Wagon Company, of Smethwick, has secured orders for twenty-five bogie petrol tank wagons, and for five four-wheeled petrol tank wagons for the South Indian Railway.

Automobile Engineering.

The automobile engineering industry in Birmingham, Coventry and Wolverhampton is just now in a state of suspense. The works are decidedly busy, and increasingly satisfactory results are being achieved in important individual instances. Export trade shows no falling off, and the home demand is keeping up well. Recent political events, however, have unsettled manufacturers, who feel that they cannot plan ahead until they know the attitude towards the McKenna duties to be adopted by the new Government. If nothing occurs to upset the trade to the advantage of foreign competitors, the ground gained at heavy cost may not be lost, but until there is something definite to go upon contemplated activities must remain in abeyance to the detriment of trade.

Warwickshire Miners' Wages.

Mr. W. Johnson (general secretary of the Warwickshire Miners' Association) states that the notices which have been given at the Exhall, Pooley Hall and Tamworth Collieries to terminate all contracts on the 43 per cent. basis have been postponed for a fortnight until the matter can be brought before the Joint Wages Board and also referred again to the Department of Mines, payment meanwhile to be made on the 43 per cent. basis. The notices in question were given consequent upon the award of Sir W. Lawrence, the independent chairman, raising the wages of the miners at the pits in question from 32 per cent. to the minimum of 43 per cent. The notices also stated that at the expiration of the fourteen days work could be had on the 32 per cent. rate. The miners employed at the Exhall Colliery have already decided not to resume work on the 32 per cent. basis.

Unemployment.

There has been an increase during the past month of some 4500 in the number of unemployed persons in the Midlands area, and although the latest returns record a slight decrease on the previous week, the position does not give rise for much satisfaction. The decrease in the Birmingham area on the week was slightly over 300, but at Coventry unemployment has increased from 2352 to 3133, while at Derby, Leamington and Warwick, Leicester, Nottingham, Oldbury, Redditch, Walsall and Worcester, there were also increases. The total for the area now stands at 150,583, composed of 114,588 men, 30,708 women, 2815 boys, and 2472 girls. The number of persons known to be working short time, to be idle temporarily or to be in casual work, and who are included in the total given above, is 55,288.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Industrial Position.

SOMEWHAT mixed conditions in engineering are again reflected by the Manchester Chamber of Commerce in the course of its monthly survey of the general industrial situation in Lancashire. Discussing the engineering trade in May, it points out that, although not active all round, it has had a good month on the whole. Textile machinists have had few orders for the home trade, but a substantial amount of business has been placed with them for the Far East and the Continent. Russia is reconditioning her cotton mills as fast as her circumstances permit, and Lancashire firms, whose machinery has stood the test of time in the past, are not being overlooked. France has increased her orders substantially, and Germany has shown more interest in textile machinery. India, China, and Japan have also placed fairly good orders. Locomotive builders have a good deal of work in hand, and cable makers have continued particularly active. Boilermakers, and colliery and railway engineers have been less satisfactorily placed, but electrical engineers and motor firms have been fairly well engaged. Machine tools have been in good demand, and the trade done shows that the improvement in various sections of the engineering trade has continued.

Power Station Fumes.

Still one more point of rivalry between Liverpool and Manchester has arisen. Liverpool's new power station, to be constructed on the site of the old Clarence Dock, will, it is claimed, strike a new note in power station practice in that no noxious fumes will be emitted, while the reason why Manchester is behind in this respect, according to Mr. F. C. Wilson, the Chairman of Liverpool's Electricity Committee, is because Manchester has made no attempt to suppress the fumes. Mr. Wilson makes the further claim that, when erected, the new Liverpool station will be two or three years ahead of anything in Manchester or elsewhere. A good deal is expected from the point of view of noxious fume prevention from a new device of Mr. Percy Robinson, the Liverpool electrical engineer. Up to the present no working details have been published, though the claim is made, backed up by independent expert opinion, that the device will eliminate all noxious fumes from the chimneys of the new station. The tender of the Metropolitan-Vickers Electrical Company, Trafford Park, Manchester, for the supply and erection at the station of a 50,000-kW turbo-alternator, at a cost of £193,370, has been accepted by the Liverpool City Council.

In Charge of £10,000,000 Water Scheme.

Mr. L. Holme Lewis, the Manchester waterworks engineer, who will be in charge of the Corporation's new water supply scheme at Haweswater, which is estimated to cost about £10,000,000, began his engineering career in 1882 as a pupil with the Hydraulic Engineering Company,

Ltd., London and Chester, and when nineteen years of age he was appointed Lecturer in Applied Mechanics and Hydraulics at the School of Science and Art, Chester. This position Mr. Lewis held for three years, when he was appointed resident engineer of the Hydraulic Engineering Company for Liverpool and district. He became engineer and manager for the Manchester Corporation hydraulic power supply undertaking in 1895, and in 1915 he was appointed waterworks engineer. Mr. Lewis is a member of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the British Waterworks Association, and also of the Ministry of Health Joint Advisory Committee on River Pollution.

New Sewerage Schemes.

Cheshire County Council is securing expert advice on the practicability of carrying out a comprehensive sewerage scheme for an area of North Cheshire lying between Carrington on the west and Cheadle and Gatley on the east. Whitefield (Lancashire) District Council has secured the sanction of the Ministry of Health for the construction of a sewage works in the adjacent township of Unsworth, and it is expected that the Ministry will shortly sanction the financial aspect of the scheme, which is estimated to cost about £22,500.

Current for Electrified Line.

It is understood that the London, Midland and Scottish Railway Company has completed arrangements with the Manchester Corporation and Stretford District Council for the joint supply of electric current for the line between Manchester (London-road Station) and Altrincham, electrification work on which is making steady progress.

Bury Engineering Appointment.

Bury Town Council has approved a recommendation that Mr. John Chadwick be appointed borough engineer in place of Mr. J. A. Settle, who has resigned, at a salary of £650 a year. Mr. Chadwick has been deputy borough engineer for about six years.

Non-ferrous Metals.

In some sections of the non-ferrous metals market during the past week consumers appear to have been taking rather more interest than of late, an important factor in the situation probably being a gradual return of confidence, which has been notably absent for some time. Both copper and tin are dearer on balance, although in neither case has there been much evidence of a speculative "bull" movement. A certain amount of buying interest in refined descriptions of copper has been shown by cable manufacturers, and transactions in standard brands of the metal have been on a fair scale. Largely on the strength of the fact that stocks in this country are not too plentiful, standard has advanced on the week to the extent of 30s. to 50s. per ton, according to position. Tin also has attracted some attention, and an improvement in the statistical position has had a steadying influence, values of foreign cash metal, for the first time since April, having gone above the £200 mark, the rise since last report being about £3 10s. per ton. There has been a moderate call for lead, and quotations have kept steady, but on the whole the demand for spelter has been very moderate and prices have lost ground slightly.

Iron and Steel.

A welcome feature of the pig iron market here has been a perceptible improvement in the early part of the week in forward buying over the next two or three months, although during the last day or two this has tapered off somewhat. Whilst it lasted, however, sellers disposed of a satisfactory tonnage in the aggregate, and coupled with the fact that contract specifications are flowing steadily in, the majority of them have reason to be satisfied with a position which represents a substantial improvement compared with the second half of last year. Quotations are firm generally, with Derbyshire at 72s.; Staffordshire at 73s.; Middlesbrough at 83s.; Scotch at up to 92s.; and West Coast hematite at 86s. 6d. to 87s. per ton—all delivered equal to Manchester. The weak spot in the steel market in Lancashire is the relatively poor demand for steel against contracts, and the position of few firms in this branch of engineering at the moment can be described as satisfactory. Boilermakers are also taking small supplies, but there is a fair demand from locomotive engineers, and in the aggregate from general engineers. Acid boiler plates remain very firm at £9 17s. 6d. per ton, with basic sorts at 5s. less; whilst joists are quoted at £8 2s. 6d., tank plates at £8 17s. 6d., large bars at £9 2s. 6d., and small re-rolled bars at from £8 5s. to £8 10s. There has been a certain amount of easing off apparent in foreign steel bars, but apart from this, and in spite of the comparatively poor sales on this market, the prices being asked here for imported products, both finished and semi-finished, are generally up to the levels that have recently been ruling.

BARROW-IN-FURNESS.

Hematite.

As far as the hematite pig iron trade is concerned, the demand continues to be steady, and customers are placing orders, not only for immediate requirements, but to cover their needs for the future. The local demand on steel account is easier, owing to the steel departments not being fully employed. This will mean that there will be more iron available for disposal. At the present time there are no signs of any falling off in the demand for iron. Business in special qualities continues to be steady, and apart from home trade there is a certain amount being done with overseas customers. Orders from the Continent are steady, if not heavy. The contract for the supply of about 40,000 tons to America is almost completed, but it is more than likely that there may be further orders placed. Iron ore from local mines is in steady demand, and there is a fair tonnage going out of the district. Foreign ore continues to be in steady demand, and imports to various West Coast ports are regular. The steel trade is not good, and both at Barrow and Workington the rail departments are not in full production; in fact, Workington is getting short of orders. The steel trade so far as railway material is concerned is getting thin, and fresh orders would be welcomed. Competition is keen. There is a better state of affairs as regards hoops, the demand on overseas account being steady.

SHEFFIELD.

(From our own Correspondent.)

Basic Steel Improves.

THE most pleasing feature of the steel trade situation is the improvement in the demand for basic steel. For a considerable time past the basic steel departments had been the busiest in the trade, but recently a falling off was noticeable, and in view of the comparative slackness in connection with acid steel the tendency was serious. Now, however, the demand is picking up again, and, in fact, already has become quite brisk, the output meeting with a fairly ready sale. It is questionable whether the call for acid steel has ever been so quiet as at the present time, and very few acid furnaces are working. There continues to be a good market for special steels, and the departments concerned with motor car steel, stainless steel, cold rolled strip, drop forgings and tool steels are fairly busy. Most steel works, however, are far from active, for few substantial orders have been placed during the last month and inquiries are disappointing.

North Lincolnshire Activity.

An entirely satisfactory state of affairs exists in North Lincolnshire. Whilst the Sheffield district firms that are on full time are exceptional, the demand in Lincolnshire has become so great that extensions of the melting plants are being undertaken. At the Redbourne Hill Works, Scunthorpe, a third open-hearth furnace has just been started, whilst a new blast-furnace and a new open-hearth furnace are being erected at the Normanby Park (Scunthorpe) works of Lysaghts, Ltd.

Oil Refineries Scheme.

North Lincolnshire will also benefit considerably from the decision of a new company, Petroleum Refineries, Ltd., with a capital of £500,000, to establish oil refineries on the Lincolnshire side of the Humber for the purpose of "cracking" British coal oils and petroleum oils. These refineries are to be set up alongside the Admiralty Oil Depôt at Killingholme, on a site consisting of 53½ acres, and the preliminary work of preparing the site and the building of bungalow dwellings has commenced. The process to be followed at Killingholme is that of extracting motor spirit and bunker oils from the by-products of low temperature carbonisation. While the works of the firm of Doncaster Coalite, Ltd., will manufacture domestic smokeless fuel, motor spirit, tar, oils, &c., from the small coal and slack produced at the Askern Colliery, Doncaster, the refineries at Killingholme will convert the oil resulting from the low temperature carbonisation into petrol and other products. The position of the refineries will enable the company to have its own jetty on the Humber bank, so that it will be possible to send its products to the Midlands markets by barges, the cheapest form of transport, and the Admiralty Oil Depôt has granted the company a twenty-one-year agreement to use its pier for the purpose of unloading incoming barges of crude oil. Three large tanks with a total capacity of 4½ million gallons, together with the necessary pipes and pumps for loading and unloading, are to be erected.

Order for Lincoln Firm.

It is stated that Robey and Co., Ltd., of Lincoln, have secured a large part of a £50,000 order which is coming to Britain for decorticating machinery to deal with the sisal plant in East Africa.

Railway Steel Position.

Railway steel has provided the weakest spot in the steel trade situation for a long time past. The British railway companies have not placed any large contracts this year, their orders being confined to comparatively small quantities which cover weekly requirements. They are keeping down their expenditure to the lowest possible limit, there being many more wagons in the country than are required for existing traffic. In this connection it is interesting to note a resolution passed at the annual meeting of the Associated Chambers of Commerce protesting against railway companies manufacturing plant for their own use rather than letting the work out to private companies. There is a proposal that the Sheffield Chamber of Commerce shall call together a representative meeting of Chambers interested in the manufacture of rolling stock material, with a view to placing before the railway directors the considered view of the Chambers, with the idea of persuading the companies not to extend their manufacturing plants, but to give more orders out to the private manufacturing firms in order to enable them to lessen their costs of production, and so make it possible to compete on better terms for foreign orders. The chairman of the Leeds Chamber of Commerce (Mr. T. F. Braime) has expressed views in favour of the proposal, pointing out that there has been a tendency in recent years for railway manufacturing plants to be extended, and where in the past small companies have been in the habit of ordering from private firms, nowadays the increased manufacturing plants of the four big groups have been taking away those orders from the private firms and placing the firms in a very much worse position when they are competing for foreign orders. He has pointed out that if the private companies were fed with orders from the home market by the railway companies, it is only common sense that they would be able to reduce their costs of production, and to sell to the railway companies at a lower price, at the same time being able to compete successfully in the foreign markets.

Orders for Rolling Stock.

In view of the foregoing, it is interesting to note that the Crown Agents for the Colonies have placed contracts for eight three-cylinder express passenger locomotives for the Federated Malay States Railways with the North British Locomotive Company, Ltd., and for seventy-five goods wagons and two vans for the carriage of motor cars for use on the Tanganyika Railways and eleven brake van underframes for the Kenya and Uganda Railways with the Metropolitan-Cammell Carriage Wagon and Finance Company, Ltd. The latter concern has also received orders for twenty-five bogie tank wagons for the Union of South Africa Railways, and ten all-steel bogie coaches for the Cardoba Central Railway, and for 294 light type bogie frames and thirty-three heavy type bogie frames required for passenger rolling stock on the London and North-Eastern Railway.

Unnecessary Competition.

Interesting comments are made in the report of the Sheffield firm of William Cooke and Co., Ltd., for the year ending March last, when the net loss for the year, after providing for depreciation, was £17,526. It is stated that although there has been some improvement in the amount of trade done, conditions are not yet satisfactory. The wire rope trade, it is stated, is suffering because of unnecessary competition, and the same can be said of the wrought iron and horseshoe trades. The importation of iron and steel from the Continent is still militating against the company making profits and the men working full time.

New Torque Converter.

An interesting new device for driving locomotives, heavy automobiles and mechanical appliances of various kinds is now being developed at the River Don Works, Sheffield, of the English Steel Corporation. This is the Vickers-Coats torque converter, and it is claimed that the invention will revolutionise the application of Diesel engines for railway work, since it renders possible the starting without shock of a heavy train from rest, with the engine running at full speed. It will, it is said, do away with the gear-box and clutch in the larger type of cars, and is also applicable to all classes of presses, pumps, capstans, and other similar mechanical contrivances. The maximum torque effort delivered by the converter is approximately three and a-half times the engine torque. It is a hydraulically operated apparatus with few moving parts, thus being to a large extent immune from wear, and is extremely simple in operation, compact and light. It has already been tested on a motor car without a gear-box or clutch with completely satisfactory results.

NORTH OF ENGLAND.

(From our own Correspondent.)

Idle Ironworks to Restart.

THE outstanding feature in iron and steel trade circles in the North of England this week is the decision of the Linthorpe-Dinsdale Iron Company to restart its works at Middleton, which have been closed down nearly three years, owing to the depression in the iron trade. Two blast-furnaces will be put into operation early next month, and they will bring the number in operation to forty-three. Two other furnaces in the district are being prepared for relighting. A period generally regarded as the quiet season of the year, is now being entered upon in the iron and steel trade, but as yet no marked falling off in the volume of trade is noticeable. Indeed, in one or two branches some expansion of transactions is reported. Confidence in the future is indicated by the disinclination of iron and steel producers to enter into anything like extensive forward contracts, except on higher terms than have been obtainable recently. As home customers are understood to have by no means fully covered their requirements, and as firms abroad are being attracted to this district, early release of further substantial orders is expected. Resumption of keen continental competition is not looked for, though it is realised that little advance in prices of products in this area is needed to let in, once more, foreign firms to districts that were drawing for awhile supplies from abroad, but of late have been returning to the use of Cleveland iron and steel.

Cleveland Iron Trade.

There is still no relief regarding Cleveland pig iron supplies. The withdrawal of the makers from the market gave merchants an opportunity to sell, at profitable prices, the supplies of which they retained command, but those stocks also have now almost completely vanished, and purchases have been almost impossible to negotiate. This is all the more unfortunate, for there are undoubtedly opportunities for a healthy export trade, if only iron were available. Instead, we now have local consumers buying Northamptonshire iron in substantial quantities, and orders for Cleveland iron are being turned away. In the circumstances, it is difficult to name a price, but makers have already indicated that they will demand 72s. 6d. per ton for No. 3 G.M.B. Cleveland pig iron, when they have more to sell, and buyers would have to pay somewhere near that figure to purchase small parcels from merchants. On that basis, No. 1 foundry iron is 75s.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade an advance is still delayed, and shrewd buyers are seizing the opportunity to place heavy forward contracts at 74s. per ton. Possibly the prospective increase of the output tends to keep prices stable, but in comparison with foundry iron, hematite prices are very low. Producers are fully sold for this month, and have good contracts for delivery over periods to the end of July.

Ironmaking Materials.

The foreign ore trade presents no new features. Consumers are well bought, and merchants have little to

offer, so that business is little heard of. Market rates are based nominally on 23s. c.i.f. Tees for best Rubio, but it would be difficult to make purchases of moment on such terms. Blast-furnace coke threatens to become more scarce, and prices show further upward tendency. Good average qualities command 20s. delivered to works in this area.

Manufactured Iron and Steel.

Active conditions prevail in the manufactured iron and steel trade. Output of manufactured iron is large. Firms have substantial orders to execute, and report a fair amount of new work coming forward. In the semi-finished steel departments order books assure activity of plant for some time ahead, and inquiries circulating are on quite a good scale. Demand for finished steel is somewhat irregular. Overseas customers are in the market, but are buying spasmodically. Home users are fairly well covered for the time being. All quotations are very firm.

The Coal Trade.

The Northern coal trade maintains its full recent strength, and it is not too much to expect that values will hold for all this month's supplies. During the past few days, however, there has been some uneasiness about the future, owing to the absence of any special new business. While the home trade continues active, and merchants have large inquiries from abroad, consumers in other countries are showing hesitancy to come on the market at present figures, indicating that prices have reached a level which may have a retarding effect on forward business. Continuity of output at present prices might be much more advantageous than any further spurts in quotations to cause buyers to look round more widely for supplies. All the markets in this country are not so busy as that on the North-East Coast; therefore, competition at home may be no inconsiderable factor ere long. For the present, however, the position is strong, and there are likely to be heavy shipments of all qualities of Northumberland and Durham coals to the end of the month. Most of the June output of coal is sold, and it only needs a regular supply of tonnage to keep the collieries at full work. Some brands of coal, second bunkers, and inferior coking coal are more freely offered, but no concessions are being made in regard to price, particularly as consumers are inquiring for early supplies. The tonnage supply seems to be adequate for immediate shipments, but shippers are finding it none too easy to cover steams further forward. This may yet prove a setback to individual collieries. Northumberland steam coals are steady at unchanged prices. Best qualities are well sold ahead, and quote direct 15s. to 15s. 6d. firmly, but there are second-hand sellers for late June at discounted prices. Tyne primes keep to 14s. 3d., with seconds 13s. 6d. to 13s. 9d. Small steams maintain late prices, ranging from 9s. to 10s., according to description, and there continues to be a satisfactory inquiry. Orders for Durham steams are numerous, and there are not many sellers for this month. Large kinds are 18s. for prompt, and smalls 12s. to 12s. 6d. Gas coal requirements are still fairly considerable, and full recent prices have to be paid. Bests are 16s. 6d., specials 17s. 6d., and seconds 16s. to 16s. 3d. Coking coals are in somewhat better offer, but prices are upheld at from 16s. to 17s. 6d. for good qualities, with lesser kinds at around 15s. 6d. In the bunker coal trade, secondary brands are in fair offer, but are unchanged at around 16s. Best and superior bunkers are scarce and maintaining 17s. to 17s. 6d. There is a steady demand for all makes of coke, and the undertone of the market is encouraging makers to increase the supply where possible. Gas coke is scarce, and firm at 22s. Patent cokes are steadier at 19s. to 20s., and beehive and superior cokes command from 26s. to 28s. 6d.

SCOTLAND.

(From our own Correspondent.)

No Material Change.

On the whole, there has not been any appreciable change in the position of the steel, iron, and coal markets during the past week. In some departments, perhaps, there has been a slight easing in the demand, but in others business has continued along steady if quiet lines.

Steel.

While perhaps it may be said that works are steadily employed, there is still ample room for improvement, more especially in respect of forward business. Outputs of plates and sections are moderate, but makers would welcome prompt orders in each, and particularly for plates. At present steel makers are meeting with more success in competition for sheet makers' raw materials, owing to the scarcity and higher price of the foreign material. Sheet makers report a moderate turnover in light sheets, but a continued scarcity of business for the heavy descriptions. The demand for tubes is steadily maintained, and outputs are heavy, especially in the seamless and butt-welded sections.

Iron.

The bar iron works are very quiet, and there is no immediate prospect of a change for the better. Prices are unchanged. Apart from a sustained demand for tube strips, re-rolled steel is comparatively quiet, and prices are maintained chiefly owing to output costs being on a high level.

Pig Iron.

Pig iron sales, especially in the case of foundry qualities, are not extensive, but there has been a little more interest noticeable during the past few days, in view of a possible increase in prices.

Scrap.

There has been an easier tone in the scrap market during the past week, but, on the whole prices have shown little, if any, deviation from recent levels of 77s. 6d. per ton for heavy steel scrap and 72s. 6d. for heavy basic, as supplies have not yet become adequate.

Steel Exports.

Throughout the past week over 7000 tons of steel products were shipped from the Clyde to the Colonies, Japan, China, Germany, and South America.

Coal.

The decline in the home demand is being severely felt in the Lanarkshire district. Idle time is all too prevalent, and in all probability some pits will close down until such time as the demand improves sufficiently to warrant a resumption of operations. Shipping business, also, is on restricted lines, and only in the case of Fifeshire steams is there any satisfactory turnover in large fuels. First-class Fifeshire steams are, in fact, finding a ready outlet at from 14s. to 14s. 6d. per ton. With the decline of business in large coal and the consequent accumulation of unsold fuel, washed materials have become scarce and available supplies are readily disposed of at full recent prices. Aggregate shipments for the past week amounted to 218,754 tons, against 258,706 tons in the preceding week and 202,475 tons in the same week last year.

Advance in Pig Iron.

Pig iron makers have advanced their prices of foundry qualities by 2s. per ton, making the minimum quotations 77s. No. 1 and 74s. 6d. No. 3 foundry per ton. Basic iron has been raised by 1s. per ton to 75s. 6d. at furnaces.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THERE has been singularly little change in the general state of the steam coal trade, except that the conditions are perhaps quieter, though that is not altogether surprising, inasmuch as there is usually a falling off in the demand during the summer time, while shippers at the present time have to contend with a shortage of tonnage. Quite a good number of orders are held, but exporters are experiencing difficulty in securing the tonnage most suited to their particular requirements. A feature, perhaps, of the market is the unevenness of the position as between individual concerns, for, while some collieries, mainly those producing the best descriptions, are very comfortably off and are booked up for the whole of this month, others are badly in need of business. Collieries as a whole cannot be equally well off as regards an outlet for their production when the daily returns respecting the docks shows that the number of idle tipping appliances has varied from about twenty to over thirty, as was the case last week, while on Tuesday of this week there were as many as twenty-seven idle appliances, and only five steamers were waiting to get into berth. The current inquiry for coals can only be described as fair, except in the case of sized descriptions, but there are several contract inquiries. The Great Northern Railways of Ireland are in the market for 50,000 to 100,000 tons of locomotive coals for delivery over the remainder of the year, and the Admiralty have asked for prices for 25,000 tons of sized coals. The Madrid, Saragossa and Alicante Railways of Spain are open for 25,000 tons of Welsh coals for delivery over the next three months, and the Central Railways of Brazil, which a short time ago asked for prices for 200,000 tons of steam coals, but did not purchase coals from this district, have again come on this market for prices for 100,000 tons of superior quality steam coals for delivery at Rio de Janeiro during July, August, September and October.

G.W.R. Company and Dock Charges.

The recent announcement by the Great Western Railway Company of its intention to apply for an Order giving it power to increase the maximum rates chargeable for the use of its docks and appliances follows upon the decision of a Select Committee of the House of Commons in March last declining to authorise the continuance of the charges in force for an additional period of five years. The rates now in operation continue to the end of next September, and unless the Great Western Company obtains a new order then pre-war rates come into force as from October 1st. The notice now given is for power to increase the existing maximum of 60 per cent. above the pre-war rate to 75 per cent., and to raise the charge for the shipment and weighing of coal and coke from 7¼d. to 8d. per ton. Taking the charges all through, the average maximum new rates if put into operation would mean an increase of about 10 per cent. upon those now in operation. It does not, of course, follow that the Great Western Company would enforce them if it had the powers, and there is no doubt that the traders will take steps to resist the application of the company, if indeed they do not make out a good case for a reduction in some of the charges now operating. The question will, of course, come before the Railway Rates Tribunal, and it will be for the company to make out its case for charges in excess of those prevailing in pre-war times.

Fuel Combine.

Reference was recently made to the proposal for the amalgamation of the patent fuel concerns in this district, the first complete scheme of rationalisation to be attempted in South Wales. It is now reported that the new company to be formed will be styled British Briquettes, Ltd., and the nominal capital of the undertaking will be in the neighbourhood of two million pounds. The interests which will be acquired embrace those of the Anchor, Arrow, Crown Preserved, Graigola Merthyr, Pacific, Phœnix, Rose and Star patent fuel companies. The Star Company is not at present producing, and it is understood that its proposal to construct new works on the west side of Roath Basin, Cardiff, has been abandoned. Sir John Beynon, Bart., will be the chairman of the new company, which will have its own offices at Cardiff.

Miners' Wage Agreement.

There was a special meeting of the South Wales Coal Trade Conciliation Board at Cardiff on Monday, when the coalowners' suggestion that negotiations for a new wage agreement should be entered upon came up for discussion. Unofficially it is reported that the chairman for the owners' side explained that their object was to endeavour to effect an early settlement so as to stabilise industry and enable collieries to enter into business ahead without the fear of interruption of production. The present agreement automatically comes to an end at the close of this year. There was a full exchange of views regarding the owners' proposal, but it is understood that the general secretary of the South Wales Miners' Federation pointed out that at the present time the workmen's representatives could not negotiate for the arrangement of a district agreement, as it was the object of the leaders to press for a national agreement. The South Wales Miners' Federation would consult the national body, and he suggested that the coalowners should adopt a similar course. The meeting therefore stood adjourned.

LATER.

Following on the meeting of the Conciliation Board on Monday, an official statement has been issued by Mr. Finlay A. Gibson, secretary of the South Wales Coalowners' Association, regarding the proceedings. In view of unauthorised versions having been published, Mr. Gibson states that it is necessary for the owners "to make known the fact that Mr. Evan Williams, on behalf of the owners, made it perfectly clear that there was no possibility of any negotiations for a national agreement, and that an agreement for the South Wales coalfield must be negotiated between the owners and the workmen's representatives in the district without the intervention of any other party."

Current Business.

The general tone of the steam coal market is quiet, but the conditions are very patchy. Most of the coals are practically on the new minimum, so far as large descriptions are concerned, but sized coals are very scarce and firm, while smalls generally are by no means in excessive supply, mainly due to the fact that a number of collieries are not working at full pressure owing to the reduced volume of business for large coals. Admiralty large and best Monmouthshire large coals are very steady, but lower grades display much irregularity. Coke finds a ready outlet, and patent fuel shows no change, while pitwood is a quiet section.

LAUNCHES AND TRIAL TRIPS.

SUECIA, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Swedish Lloyd Steamship Company, Göthenburg; dimensions, 376ft. by 50ft.; to carry passengers and cargo. Engines, Parsons steam turbines; trial trip, June 4th.

CITY OF DIEPPE, steamship; built by Wm. Gray and Co., Ltd., to the order of Ellerman Lines, Ltd.; dimensions, 486ft. 3in. by 58ft. 3in. by 34ft. 11in.; to carry cargo. Engines, quadruple-reciprocating engines combined with exhaust steam turbine; constructed by the builders and Swan, Hunter and Wigham Richardson, Ltd., respectively; trial trip, June 5th.

No. 872G, twin-screw steamer; built by Harland and Wolff, Ltd., to the order of David MacBrayne (1928), Ltd.; dimensions, 200ft. by 34ft. by 11ft. 6in.; to carry passengers and cargo. Engines, triple-expansion; constructed by J. G. Kincaid and Co., Ltd.; launch, June 6th.

MASUNDA, single-deck cargo steamer; built by Alexander Stephen and Sons, Ltd., to the order of Maclay and McIntyre, Ltd.; dimensions, 402ft. by 54ft. 9in. by 31ft.; to carry cargo. Engines, triple-expansion; constructed by the builders; launch, June 6th.

ENGINEERING GOLFING SOCIETY.—The spring meeting of the Engineering Golfing Society was held at Deal, over the course of the Royal Cinque Ports Golf Club, on Saturday and Sunday, 8th and 9th inst. On the Saturday morning, four-ball foursomes were played against bogey. The "Timmis" Challenge Cups and Mementoes were won by R. J. M. Inglis and J. R. Dallmeyer with 5 up; the second prizes going to E. C. MacKellar and F. H. Rogers with 1 up. In the afternoon there were two-ball foursomes against bogey, when the first prizes went to G. N. Watney and A. H. Gilling with 3 down; the second prizes falling to C. W. Myddleton and W. R. Manning with 5 down. On the Sunday morning there was a medal round, and in the first division the "President's" Challenge Cup and Memento were won by R. J. M. Inglis with 80 — 5 = 75; the second prize being taken by J. R. Dallmeyer with 83 — 8 = 75. In the second division the "Wilson" Challenge Cup and Memento were won by William Phillips with 93 — 12 = 81, and the second prize by W. W. Hughes with 92 — 11 = 81. The "Captain's" Prizes for the best scratch scores in both divisions were won as follows:—First division by C. W. Myddleton with 82; second division by W. W. Hughes with 92. In the afternoon friendly matches were played.

THORNYCROFT'S SCHOOL AT BASINGSTOKE.—For a number of years past John I. Thornycroft and Co., Ltd., have maintained a works school at Basingstoke. It is provided with a class room, a drawing-office and laboratory, and two masters devote their whole time to instruction. Both pupils, who pay a premium, and apprentices are required to attend classes during their years of training; the former attend the school for one morning and one afternoon, seven and a-half hours in all, during the week, and the apprentices for one morning, four hours per week. There are nine classes, averaging about eleven students each. Special attention is paid to home work. Close connection between the teachers and the works is maintained and is reflected in the lessons, any new development in the firm's methods and products being discussed in the classes. The instruction given has a very definite objective. In the case of pupils it is the associate membership examination of the Institution of Mechanical Engineers, and in the case of apprentices the examination of the Institution of Automobile Engineers. The Board of Education, which has no voice in the management, has hitherto refused to recognise the school, but as the result of a recent report made by one of its own inspectors it has decided to do so, and the school is now classed as "efficient under Clause 6 of Rule 16." The firm did not desire and will not receive a grant from the Board.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/–
(1) Spanish	24/–
(1) N. African	24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	23/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 18 0	—
No. 1 Foundry	3 17 0	—
No. 3 Foundry	3 14 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 14 0	3 14 0
No. 1	3 14 6	3 14 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
„ „ Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 10 0	—
Forge	3 6 0	—
(1) Derbyshire—		
No. 3 Foundry	3 13 6	—
Forge	3 9 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 4 6 (*a*) / 4 7 6 (*b*) / 4 11 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 10 0	—
Second Quality Bars	10 0 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 2 6	—
Gas Tube Strip	10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	9 0 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0 to 13 12 6	to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates	12 15 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
„ (Small Round)	8 5 0 to 8 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	8 10 0	—
MIDLANDS—		
Small Rolled Bars	8 7 6 to 8 15 0	—
Billets and Sheet Bars	6 10 0 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (cash)	202 5 0
„ „ (three months)	205 5 0
Copper (cash)	76 7 6
„ (three months)	75 7 6
Spanish Lead (cash)	23 11 3
„ „ (three months)	23 12 6
Spelter (cash)	26 6 3
„ (three months)	26 1 3
MANCHESTER—	
Copper, Best Selected Ingots	80 10 0
„ Electrolytic	84 15 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3½
Brass Tubes (Basis Price), lb.	0 1 1½
„ Condenser, lb.	0 1 3½
Lead, English	25 5 0
„ Foreign	23 15 0
Spelter	26 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/11 per lb.	
Ferro Tungsten	2/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£24 0 0	7/–
„ „ 8 p.c. to 10 p.c.	£23 10 0	6,–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£36 0 0	12/–
„ „ „ 1 p.c. carbon	£38 0 0	15/–
„ „ „ 0·70 p.c. carbon	£42 0 0	17/–
„ „ „ carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
FerroManganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
„ „ 75 p.c.	£19 10 0 scale 6/– per unit	
„ Vanadium	13/– per lb.	
„ Molybdenum	4/– per lb.	
„ Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

LANARKSHIRE	Export.
(f.o.b. Glasgow)—Steam	13/–
„ „ Ell	14/–
„ „ Splint	15/6 to 16/–
„ „ Trebles	14/3
„ „ Doubles	13/6
„ „ Singles	12/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	16/6
„ „ Trebles	13/9
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/– to 14/6
Screened Navigation	17/6
Trebles	14/6
Doubles	14/–
Singles	12/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/–
Secondary Steam	12/6
Trebles	14/3
Doubles	13/6
Singles	12/3

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/–
Household	38/– to 51/–
Coke	23/6 to 24/–
NORTHUMBERLAND—	
Best Steams	15/– to 15/6
Second Steams	13/6 to 13/9
Steam Smalls	9/6 to 10/6
Unscreened	13/– to 13/3
Household	21/– to 26/–
DURHAM—	
Best Gas	16/6 to 16/9
Second	16/– to 16/6
Household	21/– to 27/–
Foundry Coke	22/– to 28/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/– to 28/6 —
Derbyshire Best Bright House	20/– to 23/– —
Best House Coal	19/6 to 20/6 —
Screened House Coal	17/6 to 18/6 —
„ „ Nuts	16/– to 17/6 —
Yorkshire Hards	15/6 to 16/6 —
Derbyshire Hards	15/6 to 16/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/– to 7/– —
Smalls	2/– to 4/– —
Blast-furnace Coke (Inland)	14/6 at ovens —
Furnace and Foundry Coke (Export), f.o.b.	20/– to 21/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	19/9 to 20/–
Second Smokeless Large	19/6 to 19/9
Best Dry Large	19/– to 19/6
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/3 to 18/6
Best Eastern Valley Large	18/– to 18/3
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/6 to 14/–
Ordinary Smalls	12/6 to 13/–
Washed Nuts	20/– to 23/6
No. 3 Rhondda Large	20/6 to 21/–
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/3 to 17/9
„ „ Through	16/– to 17/–
„ „ Smalls	13/6 to 14/–
Foundry Coke (Export)	26/6 to 36/–
Furnace Coke (Export)	21/– to 23/–
Patent Fuel	20/– to 21/6
Pitwood (ex ship)	26/3 to 26/9
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	33/– to 36/6
Seconds	27/6 to 30/–
Red Vein	23/– to 27/–
Machine-made Cobbles	40/– to 44/–
Nuts	40/– to 44/–
Beans	23/6 to 25/6
Peas	17/9 to 18/6
Breaker Duff	9/– to 9/6
Rubbly Culm	9/9 to 10/3
Steam Coals :	
Large	18/– to 19/–
Seconds	17/– to 18/–
Smalls	10/6 to 13/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated. coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Tariffs and Trade.

A CURRENT feature of international trade relations is the growing tendency of continental countries to discuss their common interests so far as they are affected by the new tariff legislation of the United States. Even amongst European countries there has been a war of tariffs that aimed at the protection of new industries and, especially during the period of financial difficulty, were regarded as a source of revenue. Obviously, if something must be done to facilitate trade relations, a beginning should be made at home, and already something has been accomplished by the States of the Little Entente which have organised a sort of commercial union on a reciprocal basis. There are many in this country who believe that a general arrangement of this kind will eventually extend to the whole of the Continent. The idea appears impracticable enough, but it is suggested because it is thought to offer the only way out of the difficulty which is threatened by the exclusion of foreign goods from the United States and by the efforts that American firms are making to obtain possession of European markets. This movement presents one of the most serious problems with which Europe has yet been confronted. The debts have to be paid, and the United States will take nothing in goods, while that country is rendering the situation still more precarious by competing in European markets under conditions that must weaken them financially. At the present time practically all the French exports have declined, except iron and steel and motor cars. The new United States' Tariff Bill, has, therefore, created considerable alarm in this country, and a meeting of all the commercial and industrial associations has been held in Paris to decide upon some course of action, the main lines of which are an inquiry into the imports from the United States which are "vulnerable," an inquiry into the resources of other countries in raw material which can be substituted for that at present purchased from the United States, and the grouping together of all the European producers' federations with a view to taking such measures as may be necessary for the protection of their interests.

Colonial Development.

French manufacturers are perfectly aware that, under present conditions, they can no longer look to foreign markets as the mainstay of their industrial activity. The rising values are reducing their competitive advantages, and it will only be when the reorganisation of the works and factories now taking place is well advanced and when the work of economic development has been completed in the way of the general utilisation of hydro-electric energy and the provision of facilities for cheaper transport, that there will be any real hope of bringing down production costs to a level at which it will be possible to recover the ground that is being lost in foreign markets. Meanwhile, engineering and other firms feel that they are safe in looking to the Colonies to provide them with plenty of work for many years to come. The French believe that the future lies in developing their vast African territories, which will not only offer a field for industrial activity but will supply the country with most of its requirements in raw material, particularly cotton, wool and oils. Casablanca owes its prosperity to the phosphate trade, and it is declared that there are enormous reserves of minerals in Equatorial Africa which will be made available when the means of transport are sufficiently developed. The policy of colonial development has been well thought out and comprises one general plan of public works which will put all the African Colonies in easy communication with the mother country and will, in fact, make the territories stretching from Algeria to the Niger a continuation of France. This scheme necessarily implies the suppression of the isolation of Central Africa by the construction of the railway across the Sahara Desert and the provision of a perfectly safe route across the Mediterranean. The railway from Brazzaville to the port of Pointe-Noire, and the network of lines being constructed in the Ivory Coast district and the late German Colonies that have come into the possession of the French, will open up traffic between the interior of the Continent and the Atlantic Coast. New ports have been created. It is claimed that Dakar is becoming the largest and best equipped port on the West Coast of Africa. If the Trans-Saharan Railway is completed, there will be continuous rail and air communication as far as the Belgian Congo and from thence, with the collaboration of the Belgian Government, to the East Coast of Madagascar. A great deal of work has already been done with the aid of local finances, but it is now felt that the scheme should be pushed forward as a whole, and, for that purpose, it has been decided to raise a great colonial loan amounting to 3000 million francs. Of that sum 960 million francs will be devoted to works in Indo-China and the remainder to the West African Colonies and to Madagascar.

Harbour Works.

A complete organisation of the ports with a view to adapting them to modern conditions of maritime traffic is occupying the attention of the Association des Grands Ports Français, which has arranged with representatives of the Government, State officials and engineers to undertake a series of visits to ports at home and abroad. These visits began with one to the Port of Paris, where the new basins at Gennevilliers are intended to provide for the traffic with Rouen, while the basins at Pantin and La Villette are being enlarged and improved in order to deal with the increasing coal and other traffic by canal with the Nord. These works will make Paris the largest port in France. After visiting the French ports the commission will go to Rotterdam, Amsterdam, Hamburg and other foreign ports, and it is hoped that, with the data which will, thus, be made available, parliamentary sanction will be obtained to carry out a systematic work of specialisation which is regarded as being necessary for the welfare of the different ports.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

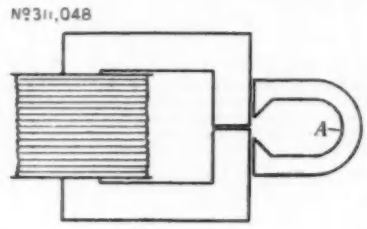
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

311,048. March 17th, 1928.—CHOKES AND TRANSFORMERS, Paul Gustavus Adolphus Helmuth Voigt, of "Bowdon Mount," 121, Honor Oak Park, London, S.E. 23.

This invention relates to iron core transformers and chokes, especially those with high permeability cores which carry a direct as well as an alternating current, and is specially intended for thermionic valve circuits. It is known that the direct current tends to polarise the core, thereby reducing the useful inductance.

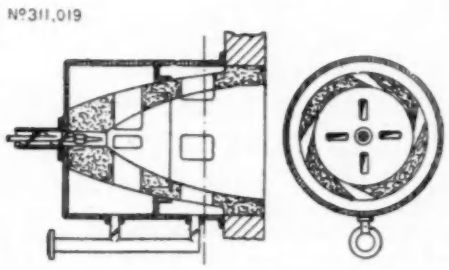


To prevent saturation it is usual to include an air gap in the magnetic circuit. According to this invention, saturation is prevented by applying near the air gap a magnet A so arranged that its flux opposes that due to the direct-current component of the current in the winding. The air gap may be made much smaller than in previous arrangements in which the reluctance of the air gap alone is relied upon to prevent saturation. With this reduction in air gap the effective impedance of the windings is increased.—*May 9th*, 1929.

FURNACES.

311,019. February 13th, 1928.—POWDERED COAL BURNERS, Büttner-Werke Aktiengesellschaft, Parkstrasse Uerdingen, a/Rhein, Germany; and H. Zikesch.

This burner is set out as being characterised by the feature that the mixture of air and fuel is admitted at the apex of a burner, the diameter of which increases towards the front end, whilst additional air is admitted tangentially at a plurality of points lying at different distances from the ends of the burner and

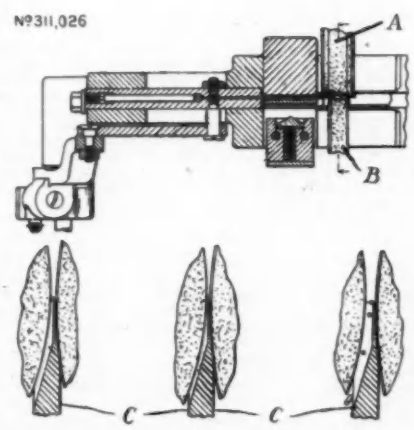


thus at different distances from the longitudinal axis of the burner, whereby the mixture of air and fuel is set in rotation by the said additional air in such a manner that the smaller particles arrange themselves towards the centre and the larger particles towards the outside in layer-like form and the whole is surrounded all along the burner by the additional air. The inventors advocate the use of the burner at unusually high pressures and velocities, examples of which are given.—*May 9th*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

311,026. February 25th, 1928.—CENTRELESS GRINDERS, *V. A. B. Hughes*, 25, *Market-street, Manchester*.

This is an elaborate specification, which is difficult to epitomise. It is concerned with a centreless grinder for producing

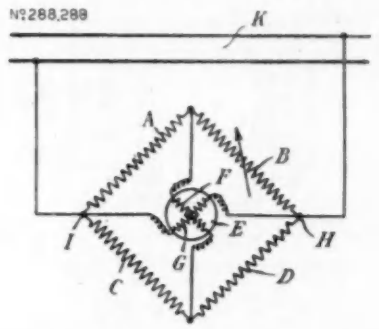


pieces of a form other than cylindrical. That is to say, the pieces may be tapered or of a curved form axially. For this reason the grinding and regulating wheels are temporarily drawn apart for the introduction of the work piece, which is inserted by an automatic magazine device. A rather peculiar form of rest is provided for the work. We illustrate only the slide, showing the grinding wheel at A and the regulating wheel at B, together with three views of the work rest C.—*May 9th*, 1929.

MEASURING AND TESTING INSTRUMENTS.

288,288. March 30th, 1928.—DEVICE FOR MEASURING ELECTRIC RESISTANCES, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

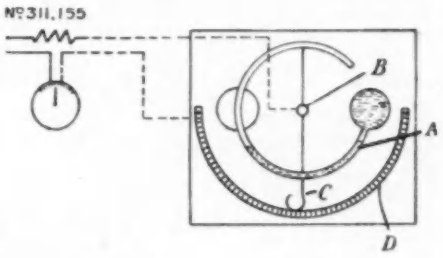
The resistance A to be measured is combined into a bridge circuit with three other resistances B C D in one of the diagonal branches of which one coil F of a cross coil instrument E is connected. The other coil G of the instrument is connected to the supply voltage taken from the conductors K, the connection being effected at points I and H. If necessary, additional resistances may be interpolated between the coil G and the



points I and H, which may be used for the adjustment of the sensitivity and which decrease or compensate the temperature coefficient. When testing the variable relation of two resistances such as A and B it is advisable to set the cross coil instrument in such a manner that it is most sensitive; that is to say, so that the cross coil influenced by the working voltage embraces the greatest number of lines of magnetic force when the relation has a given normal value. The two resistances A and B might form part of two different resistance thermometers. The cross coil element E then measures any difference between the temperature to which the two resistances are exposed.—*May 9th*, 1929.

311,155. August 16th, 1928.—APPARATUS FOR REGULATING TEMPERATURE, F. Eitel, Ginsheim/Rhein, near Maintz, Germany.

In this instrument the thermometer A has a stem bent into a circle and is mounted on a pivot B. Attached to the stem

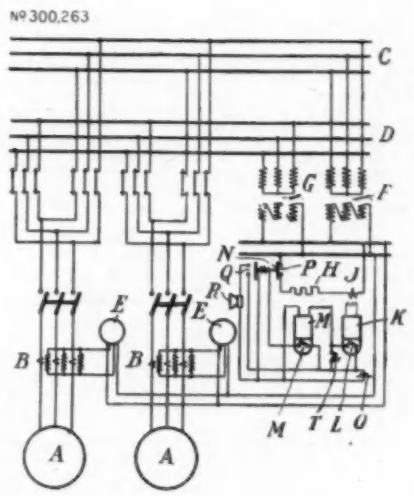


there is a contact arm C which swings over the contacts of a rheostat D. This rheostat forms part of an electric circuit which can be used for regulating or indicating purposes in connection with the temperature to which the thermometer is exposed.—*May 9th*, 1929.

MISCELLANEOUS.

300,263. October 11th, 1928.—FRAME-SHORTING PROTECTIVE DEVICE FOR GENERATOR PLANTS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The generators A are connected through the transformers B to the bus-bar systems C and D. The secondary sides of the transformers are connected in parallel and supply the current coils of the frame short circuit relays E. The frame

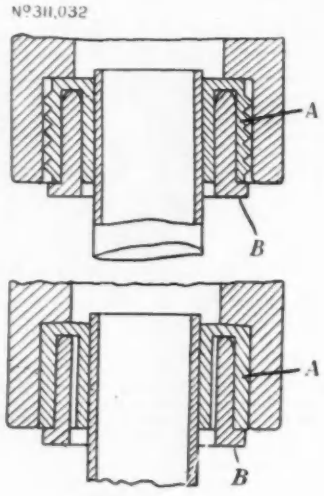


choking coil F is connected to the bus-bar system C and the choking coil G to the bus-bar system D. The open delta-connected secondary windings of the choking coils are connected in parallel and give a common supply to the voltage windings of the relays E. The open delta-parallel-connected secondary windings of the choking coils are also closed through a resistance H and a transformer J. The transformer J feeds the overload relay K, which, on operating, shorts its pair of contacts L and

thus sends a current into the short-period time relay M from the voltage source O. The time relay, on operating, closes its pair of contacts M and thereby sends a current through the current winding of the release device N. The release device operates and opens the contacts P and closes the contacts Q. The current passing through the resistance H and the transformer J is thus broken and the voltage source O is switched on to the buzzer R, which then operates. For testing the time relay M and the buzzer R a test key T, which on being depressed short circuits the contacts L of the overload relay K, is provided.—*May 9th*, 1929.

311,032. March 2nd, 1928.—PIPE JOINTS, I. D. Jack, 120, Oxford-street, Glasgow, C. 5.

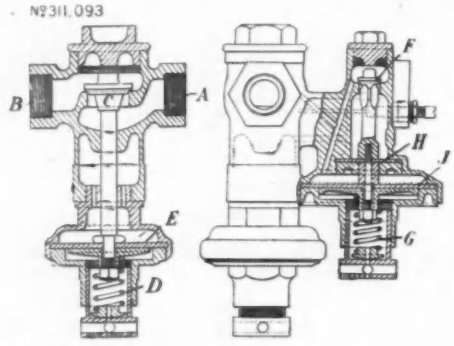
This joint is put forward as being especially applicable to the connection of metal tubes with earthenware fittings or others of a fragile nature. The joint is made by means of a packing piece



A of rubber or other resilient material. Its tightness is assured by a "distorter" F, which is forced into place after the other parts have been assembled. As will be seen from the second illustration, the inventor does not, apparently, consider it necessary that the distorter should bear on both walls of the packing piece.—*May 9th*, 1929.

311,093. May 5th, 1928.—AUTOMATIC REGULATING VALVES, Sir J. Dewrance, 165, Great Dover-street, Southwark.

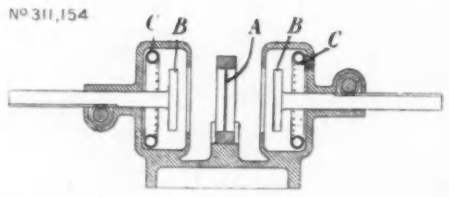
In this reducing valve the inlet is shown at A and the outlet at B. The main valve C tends to open under the influence of the spring D and is closed by the pressure on the diaphragm E.



The pressure for this purpose is supplied by the pilot valve F, which is controlled by the spring G and diaphragm H. The chamber and diaphragm J are provided for regulating purposes when the valve is used in conjunction with a calorifier.—*May 9th*, 1929.

311,154. August 14th, 1928.—DIAPHRAGMS FOR RECORDING APPARATUS, H. R. G. Moore and T. P. Rigby, H.M.S. "Vernon."

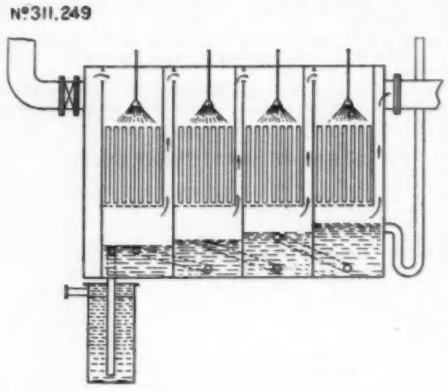
This invention relates to the production of metal diaphragms of the type in which a heavy rim is formed integral with the diaphragm or mounted on the periphery, such diaphragms being usually employed in hydrophone work. It has been found in the production of such diaphragms, particularly when the diaphragm is very thin in proportion to its diameter, that they are liable to buckle in use or during the final machining operation. According to the invention a diaphragm is suddenly clamped between a pair of hot plates of a diameter substantially equal to that of the diaphragm, and pressure sufficient to prevent buckling is maintained for a short period of time until the diaphragm is



heated up to about the temperature of the clamping plate, while the heavy rim on the periphery of the diaphragm remains relatively cold. The heated diaphragm cannot expand in diameter as it is held by the cold rim, nor can it buckle on account of the clamping plates. The material of the diaphragm may, therefore, be stressed beyond the elastic limit and takes up a permanent strain. When the clamping plates are removed the diaphragm, although heated, shows no tendency to buckle, and as it cools the permanent strain takes the form of tensile stress in the material of the diaphragm. The degree of tension is controlled by regulating the temperature of the clamping plates. The illustration shows the diaphragm at A and the clamping plates B B, together with their gas heating rings C C.—*May 9th*, 1929.

311,249. November 8th, 1927.—GAS SCRUBBERS, The Chemical Engineering and Wilton's Patent Furnace Company, Ltd., 76, Victoria-street, London, S.W. 1; N. Wilton and T. O. Wilton.

In this gas scrubber the gas and the scrubbing liquid both



travel downward. The several towers of the scrubber are packed with loose tubes, each of which contains a helical baffle. The gas passes from one tower to another and the scrubbing liquid is pumped from one to another in counter-current fashion.—*May 8th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, S.W. 1. "Repairs to Diesel Engine Parts by Electro-deposition," by Mr. C. H. Faris.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "Pressure Shifts in Line Spectra of Gases," by Mr. W. E. Pretty; "The Zeeman Effect for the Arc Spectrum of Gold," by Messrs. A. S. M. Symons and J. Daley; "The Band Spectrum of Lanthanum Monoxide," by Mr. W. Jevons. The following demonstrations will be given by Mr. G. D. Preston: (*a*) The Crystal Structure of the Allotropes of Manganese; (*b*) the Change of Physical Properties During the Age-hardening of Aluminium Alloys. 5 p.m. Editing Committee meeting. 3.30 p.m. Council meeting, 4 p.m.

TO-DAY AND SATURDAY, JUNE 15TH.

INTERNATIONAL FOUNDRY TRADES' EXHIBITION.—Royal Agricultural Hall, Islington, London, N. 1.

INTERNATIONAL HIGH TENSION CONFERENCE.—Paris. For provisional details see page 413, April 12th, 1929.

TO-DAY TO SATURDAY, JUNE 22ND.

INSTITUTION OF ELECTRICAL ENGINEERS.—France. Summer meeting. For programme see page 331, March 22nd, 1929.

SATURDAY, JUNE 15TH.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Visit to Barton Power Station. Omnibuses will leave the main entrance to Manchester Town Hall at 2 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—In the Lecture Theatre of the Institute, Newcastle-upon-Tyne. The following papers will be open for discussion:—"Roof Control on Longwall Faces," by Mr. John F. C. Friend; "Diamond Boring Applied to Tapping Drowned Areas Underground," by Mr. F. E. Smyth; "Land Drainage," by Mr. H. C. Pawson; "The Laws of Motion of Particles in a Fluid," by Mr. R. G. Lunnon; "Boring Against Workings Likely to Contain an Accumulation of Water or other Liquid Matter, and a Method of Negotiating a Fault," by Mr. C. H. Leeds; "The X-ray Analysis of Coal: the Radiographic Variables and their Control," by Mr. C. Norman Kemp. The following paper will be read:—"Burnt Outcrops of the High Main Coal at Newcastle-on-Tyne," by Mr. R. G. Carruthers. 2.30 p.m.

MONDAY TO WEDNESDAY, JUNE 17TH, 18TH AND 19TH.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer meetings at Bath. *Monday*, Council Meeting at the Spa Hotel, 5.30 p.m. *Tuesday*, members assemble at the Spa Hotel, 9.45 a.m.; 10 a.m., special meeting, paper by Dr. Margaret Fishenden and Mr. A. F. Dufton, "Heating Research at Watford, 1928–1929"; 2.30 p.m., assemble in the Grand Pump Room for a visit to the Hot Mineral Baths; 7 p.m., reception in the Ball Room at the Spa Hotel; 7.30 p.m., banquet in the main Dining Room. *Wednesday*, 9.45 a.m., motor drive to Cheddar; 12.30 p.m., luncheon at the Cliff Hotel, Cheddar; 3 p.m. leave Cheddar for Bath and return to London.

WEDNESDAY, JUNE 19TH.

SOCIETY OF GLASS TECHNOLOGY.—In the Applied Science Department, the University, St. George's-square, Sheffield. "The Glass Industry of North America in 1929," Part II., by Professor W. E. S. Turner; "The Influence of Boric Oxide on the Rate of Melting and Physical Properties of Colourless Bottle Glass," by Miss Violet Dimbleby, Mr. M. Parkin, Mr. F. Winks, and Professor W. E. S. Turner; "The Influence of Manganese Oxide on Some Properties of Glass," by Mr. A. A. Childs, Miss Violet Dimbleby, Mr. F. Winks, and Professor W. E. S. Turner. 2.30 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington. The following papers will be read:—"Potential Gradient and Atmospheric Pollution: the Influence of 'Summer Time,'" by Dr. F. J. W. Whipple; "Vertical Air Currents as Measured by Pilot Balloons," by Mr. A. J. Bamford; "Studies on the Rhone Glacier, 1927: The Relationship between the Average Air Temperature and the Rate of Melting of the Surface of the Glacier," by Dr. George Slater. 5 p.m.

TUESDAY TO FRIDAY, JUNE 25TH TO 28TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Manchester. Summer meeting. For programme see page 302, March 15th, 1929.

TUESDAY, JULY 2ND.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Summer meeting. Visit to the Avonmouth Docks. Assemble main booking hall, G.W.R., Snow Hill, Birmingham, 11 a.m.

TUESDAY TO THURSDAY, JULY 2ND TO 4TH.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Summer meeting in Newcastle-upon-Tyne, jointly with the Institution of Engineers and Shipbuilders in Scotland. "The Story of Safety at Sea," by Sir Westcott S. Abell; "Developments in the Uses of Electricity," by Mr. R. P. Sloan; "The Applications of Monel Metal in Engineering and Shipbuilding," by Mr. John Ireland; "Some Notes on Damage to Ships," by Mr. J. L. Adam.

TUESDAY TO FRIDAY, JULY 2ND TO 5TH.

BRITISH WATERWORKS ASSOCIATION.—Portsmouth. For programme see page 447, April 19th, 1929.

THURSDAY AND FRIDAY, JULY 4TH AND 5TH.

INDUSTRIAL WELFARE SOCIETY.—Eighth annual conference of Editors of Works Magazines at Norwich.

FRIDAY, JULY 5TH.

OVERHEAD LINES ASSOCIATION.—Visit to the Mid-Cheshire Electricity Supply Company. The visit will start at 12.15 p.m. at Winsford (Gravel) Station (L.M. and S.).

SATURDAY, JULY 6TH.

PHYSICAL SOCIETY.—Visit to Birmingham. The following programme has been provisionally arranged:—Leave Paddington 9.10 a.m., arrive Leamington 10.44 a.m. On arrival at Leamington the party will drive by motor omnibus, provided by the University, to Birmingham *viâ* Warwick. At Warwick a stop will be made to enable members to inspect Warwick Castle and other places of historic interest. Lunch will be taken at the University Refectory in the Edgbaston Buildings about 1.30 p.m., and thereafter the meeting will be held and the University Science Buildings will be open to inspection.

TUESDAY TO SATURDAY, JULY 9TH TO 13TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Royal Show at Harrogate.

WEDNESDAY TO FRIDAY, JULY 10TH TO 12TH.

ELECTRICAL ASSOCIATION FOR WOMEN.—Fourth Annual Conference at the North-East Coast Exhibition, Newcastle-on-Tyne.

TUESDAY TO SATURDAY, JULY 16TH TO 27TH.

AIRCRAFT EXHIBITION.—Olympia. Seventh International Aircraft Exhibition.

TUESDAY TO THURSDAY, JULY 23RD TO 25TH.

NEWCOMEN SOCIETY.—Summer meeting at Dartmouth, Devon. For programme see page 434, April 19th, 1929.

SATURDAY TO TUESDAY, AUGUST 3RD TO 13TH.

INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—Summer Tour, 1929. The Students' Section summer tour will be held this year in Paris and Northern France.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. H. A. HOWIE, borough electrical engineer of Walsall, has been appointed borough electrical engineer of Torquay.

MR. NICHOLAS G. GEDYE, M. Inst. C.E., has been elected chairman of the Committee of the Association of Consulting Engineers (Incorporated) for the ensuing year.

THE METROPOLITAN VICKER'S ELECTRICAL COMPANY, Ltd., asks us to announce that on Monday next, June 17th, it is moving its Newcastle-upon-Tyne office from Ward's-buildings, High Bridge, to Metro-Vick House, Northumberland-road, to which it requests that all correspondence should thereafter be directed. Telephone: Central 6202/3/4/5.

CONTRACTS.

THE CANADIAN LOCOMOTIVE COMPANY has received another order for the construction of two twelve-wheel locomotives for the Government of Jamaica, these locomotives being similar in type to those constructed for use in Jamaica in 1920.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., have received an order for the construction of a motor-driven oil tanker of 8800 tons deadweight capacity for Norwegian owners. This vessel will be fitted with six-cylinder "Armstrong Sulzer" two-stroke Diesel engines.

UNITED WATER SOFTENERS, Ltd., of Aldwych House, London, W.C. 2, have recently received orders from sixteen separate customers at home and abroad for nineteen separate plants for the softening and/or purification of water, the plants having a combined capacity of upwards of 7,000,000 gallons per day.

THE UNITED STEEL COMPANIES, Ltd., of Sheffield, have received the following orders:—(*a*) From the London, Midland and Scottish Railway Company, for 10,560 pressed steel railway sleepers of the Sandberg heavy type, weighing 190 lb. each; this order represents a total of between 800 and 900 tons of sleepers; (*b*) from the London and North-Eastern Railway Company, for 500 tons or nearly 6000 railway sleepers, each weighing 192 lb.

THE INSTITUTION OF MINING ENGINEERS.—The Council of the Institution of Mining Engineers has accepted a generous offer, made by Mavor and Coulson, Ltd., of Glasgow, of a sum of £300 for a further year, for a post-graduate travelling scholarship which must include Canada or the United States of America in the itinerary of the selected candidate. The award will be made by the Council of the Institution on the recommendation of a Committee of Selection, and is open to British subjects over twenty-three years and under twenty-seven years of age who are student members or associates of the Institution of Mining Engineers, and who have graduated in mining at a university or college, or taken the associateship of the Royal School of Mines and have had at least twelve months' underground experience in a colliery. Applications in respect of the award must be in the hands of the Secretary of the Institution by September 1st, 1929.